Notebook, N-88-08-28

This notebook, which covers the period August-September 1888, is a continuation of N-88-06-10. It contains transcriptions by Arthur E. Kennelly of material from the rough record books used by experimenters in the Galvanometer Room. There are notes, tables, drawings, and calculations regarding non-magnetic watches, meters, batteries, alternating current, generators, and transformers. Some of the entries relate to physiological experiments using gasoline on shellfish, insects, and other organisms. Among the experimenters whose work appears in this book are F. P. Bergh, Alex W. Brigham, E. C. Boynton, Johannes H. Cuntz, and T. F. Lawrence. There is an index at the end of the book. The front cover is labeled "Record Book No. 5 Edison Galvanometer Building." The back cover is labeled "517." The spine is labeled "75." The book contains 88 numbered pages. Some pages were removed before the book was paginated. Numerous graphs have been pasted into the book.

The index has been filmed first.

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x E-172 N-88-08-28

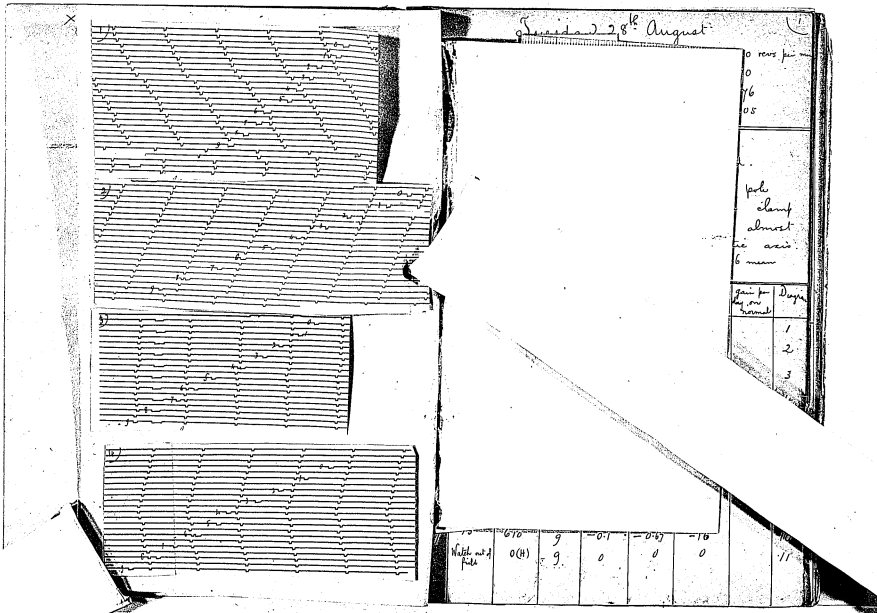
Record Book

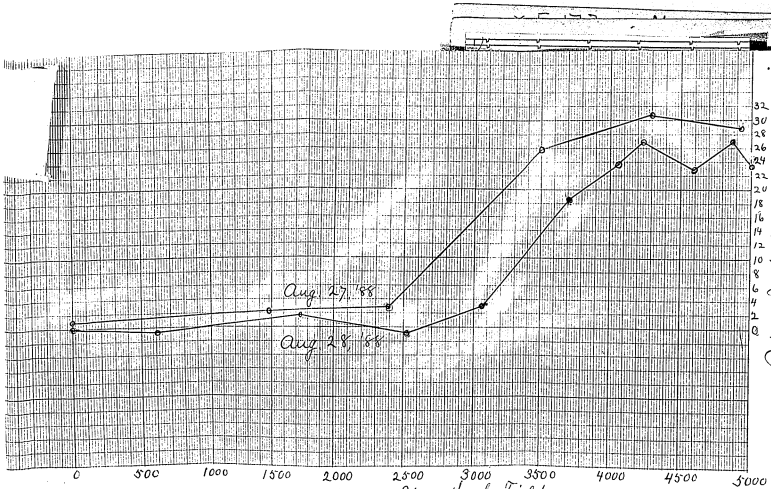
No. 5

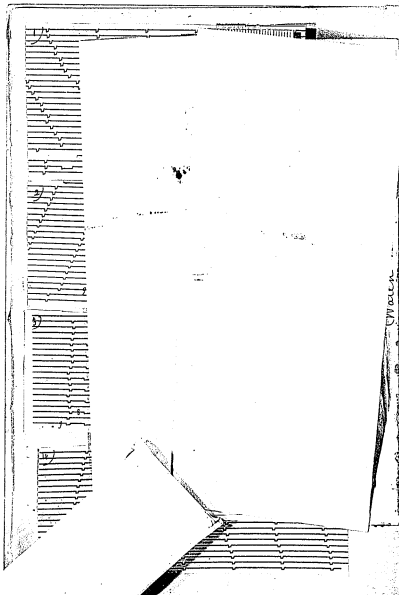
of Observations, Calculations and Data of the Galvanometer Room

Edison Laboratory

Commenced 28th August 1888.


Tuesday 28th August
0 revs per min
0
76
05
pole
clamp
almost
ie axis
6 mean
gain per day or month
Days
1
2
3
6·10
9
−0·1
−0·6
−18
Watch not of field
0(H)
9
0
0
0
11


Aug. 27, '88
Aug. 28, '88
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Strength of Field
in
C. G. S. Units.
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
Rate of Variation
in
Seconds per Hour.
Watch No. 1.



Tuesday 28th August

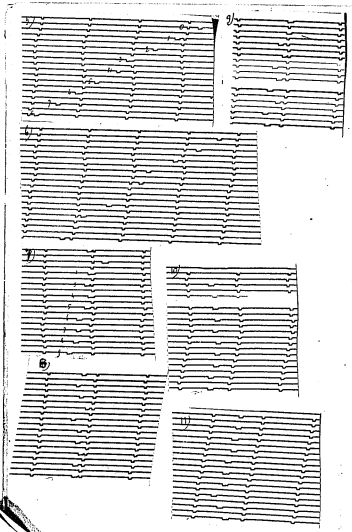
Speed of Arm. Simms Engine 240 revs per min
" " Shafting 370
" " #20 Dynamo 776
" " 130 volt 1405

Trial of rate of #1 Watch in powerful magnetic field, continued.

Pendulum e.mag. vertical. S seeking pole uppermost. #1 Watch dial up held in clamp so that its balance wheel axis almost exactly coincided with magnetic axis.

Thermo Thin. hall. galv. from 0.5# 1 c.c. 118.6 mm

Mean Tem. Galv. Poles	Mean Thermo from Field Calibration	Mean Abs. Mag. Field.	Time of Chronograph Record	Gain in this time	Gain per hour	Gain per day.	Gain per day on normal	Degree
53°.15'	122.6	5000	59	3.5	23.3	559		1
47°.45	119.5	4870	9	4	26.7	641		2
42°.0	112.6	4590	9	3.4	22.7	545		3
36°.45	104	4240	9	4	26.7	641		4
31°.15'	99.5	4060	8	3.15	23.6	566		5
28°.30'	91	3710	9	2.8	18.7	449		6
22°.30'	75.25	3070	9	0.5	3.33	80		7
18°.30'	62	2530	9	−0.1	−0.67	−16		8
12°.30'	42.6	1740	9	+0.25	+1.67	40		9
5°.7'	15	610	9	−0.1	−0.67	−16		10
0	Neither nor Field	0(H)	9	0	0	0		11



Wednesday 29th August

Record of measurements taken for the determination of λ. (Observer Kennelly 26. 8. 98)

Temp. 25°C. 1 std. cell 1.04 Ballistic galvo.

−		+
		243
220.5		
		211
191.7		
		183.6
167		
		159.8
145.7		
		138.3
126.8		
		121
110.5		
		104.9
96.3		
		91.8
83.7		
		79.1
73.6		
		69.5

$$\lambda = \log_e \frac{463.5}{231.5} = \log_e (1.0711) = 0.07114$$

$$\lambda = \frac{1}{4}\log_e \frac{463.5}{79.5} = \frac{\log_e 2.6101}{4} = 0.06926$$

Method of Record

	+ 242
	+ 18.5
− 14	+ 15
	+ 242
	+ 17 (2.5 div early)
	+ 243
	+ 18.5
− 14.3	+ 15
− 13	
	+ 12.5
− 11.5	
	+ 242.5
	+ 19.8
− 14.5	+ 15.5
+ 13	

Repetition of three trials . Observer Mr Lawrence

Temp. 21.2°C. Std. cell 1 t same galv. 29.8.18

Recoil method

	− 237
	− 17.5
	− 236
	− 17
	− 237
	− 17.5
	− 237
	− 17
	− 236
	− 16.8
	− 237.5
	− 18
Temp 21.1°C. 0.5t	− 119
	− 7
	− 118
	− 7.5
	− 117.5
	− 8.5
	− 117
	− 10
	− 118
	− 8.5
	− 118
	− 8.0

16.22 o'clock. Temp. 21.8°C. Decrement Series

14

− 236	+ 222
+ 206	
181	195
158	170.5
139	146
121	131
106	115
92	100.5
81.5	88
71.3	77
63	68
55	59
48	52
42	45.3
	40

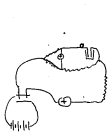
(Thursday) 30th August.

Meter tests.

Took 4 25 light meter bottles. Cleaned the zinc by immersion in dilute H_2SO_4 then amalgamated them in filtered mercury. Then after connecting them in couples immersed them in $ZnSO_4$ pure slightly acid solution of special preparation.

The 1st test was for resistance simply as follows.—

The bottles had a thermometer inserted in each, and were all put in the refrigerator the resistance of each bottle was then observed up to 30 mas. current. The current for 25 lamps might be 15 amps and of this nearly ~~too~~ part going through the bottles would be 15 milliamperes. The subjoined currents are 1% in excess of the currents actually traversing the cells, as a ratio of 100/1 was employed.



The thermometer 74.

Bottle #	Time	R in ml	Current Mins	Bridge Ratio	Res. of gauge	Ratio to Res. 25°	Res. of Bottle	Res. of crude	
1	10·45	6500	1	1000 ~/sec	2.30	0.593	0.5932+4107	1.60	
	10·47	2600	2	-	2.26			1.56	
	·49	1300	3	-	2.26			1.56	
	·51	800	4	-	2.26			1.56	
	·53	500	5	-	2.26			1.56	
	·55	250	6	-	2.25			1.55	
	·56	50	7	-	2.25	2.29		1.55	1.59
Temp. 13.5°	11·05	800	8	1000 ~/sec	2.21	2.26		1.51	1.56
	·07	700	10	-	2.21	2.27		1.51	1.57
	·10	532	12.5	-	2.21	2.26		1.51	1.56
	·14	457	15	-	2.21	2.25		1.51	1.55
	·15	385	17.5	-	2.20	2.23		1.50	1.53
	·30	330	20	-	2.21	2.23		1.51	1.53
	·34	260	25	-	2.19	2.21		1.49	1.51
	··	210	30	-	2.185	2.21		1.485	1.51
2	14.45	6200	1	1000 ~/sec	2.35			1.65	
	·50	2500	2	-	2.33			1.63	
	·52	1300	3	-	2.33			1.63	
	·53	800	4	-	2.33			1.63	
	·54	500	5	-	2.33	2.38		1.63	1.68
	15·00	180	6	-	2.38	2.38		1.68	1.68
	·03	19	7	-	2.33	2.37		1.63	1.67
	·05	895	7	1000 ~/sec	2.31	2.37		1.61	1.67
	·08	775	8	-	2.33	2.37		1.63	1.67
Temp. 12.5°	·10	580	10	-	2.33	2.36		1.63	1.66
	·12	510	12.5	-	2.33	2.36		1.63	1.66
	·14	445	15	-	2.32	2.35		1.62	1.65
	·16	375	17.5	-	2.32	2.35		1.62	1.65
	·18	320	20	-	2.31	2.34		1.61	1.64
	·19	250	25	-	2.30	2.335		1.60	1.635
	·20	200	30	-	2.295	2.33		1.595	1.63

Bottle No.	Time	Res. in ect	Revolutions Mag.	Bridge Ratio	Res. observed.	Mods. L. & S.	Res. of Depth	Res. of C. complete
3	15·22	6200	1	incorrect	2·77		2·07	
	·23	2500	2	-	2·75	2·79	2·05	2·09
	·25	1300	3	-	2·74	2·79	2·04	2·09
	·27	800	4	-	2·71	2·79	2·01	2·09
	·28	540	5	-	2·70	2·74	2·00	2·04
	·29	180	6	-	2·55	2·67	1·85	1·97
	·44	890	7	incorrect	2·51	2·55	1·81	1·85
	·47	860	8	-	2·50	2·54	1·80	1·84
	·49	675	10	-	2·46	2·51	1·76	1·81
	·51	537	12·5	-	2·44	2·49	1·74	1·79
	·53	435	15	-	2·40	2·42	1·70	1·72
	·56	383	17·5	-	2·37	2·43	1·67	1·73
	·59	318	20	-	2·36	2·40	1·76	1·70
	16·07	244	25	-	2·34	2·38	1·64	1·68
	·03	207	20	-	2·33	2·34	1·63	1·66
4	16·06	6050	1	incorrect	2·47	2·56	1·77	1·86
	·08	2450	2	-	2·50	2·56	1·80	1·86
	·10	1280	3	-	2·50	2·58	1·80	1·88
	·11	680	4	-	2·50	2·57	1·80	1·87
	·13	410	5	-	2·49	2·57	1·79	1·87
	·14	165	6	-	2·49	2·57	1·79	1·87
	·16	980	7	incorrect	2·52	2·59	1·82	1·89
	·17	855	8	-	2·51	2·55	1·81	1·88
	·19	676	10	-	2·52	2·57	1·82	1·87
	·21	536	12·50	-	2·50	2·55	1·80	1·85
	·22	438	15	-	2·48	2·52	1·78	1·84
	·24	373	17·5	-	2·45	2·50	1·75	1·80
	·26	319	20	-	2·44	2·48	1·74	1·78
	·28	248	25	-	2·40	2·44	1·70	1·74
	·29	201	30	-	2·38	2·42	1·68	1·72

Temp. 83°

Temp. 83·5

Watch Shield tests.

Took following tests of the shielding effect of two small leather cased sheet iron guards 5.8 cms in diam 1.2 cms + 0.7 cms deep constructed on the Invalids principle. Watch # 3,013,719 Elgin movement steel hair spring was used in this test.

1st Took chronographic rate of watch during 10 mins before exposing it to field. This rate see diagram 1 is apparently just the clock rate within limits of observation. Time 9.25

2nd Watch put in glass left cam movement in guard and guard in field. ^ Summit bar. 59° = 0.81

Watch left in field 10 mins 9.25/59

Field increased by average = 5+2.5 = 2.5 = 100 secs

3rd Watch removed from field and from shield. Rate tested. 9.35/59 0.65 mm

Rate = 0.65/10 = 0.065 per min = 3.9 secs gain per hour.

See diagram #2.

4th Lowest Field. Summer Tam 73°.

Throw 3 ÷ 2 = 1.5

Watch left in field 10 mins 9.45/59 throw 5 ÷ 2 = 100 secs

5th Watch removed from field + shield + kept tested 10. 15/59 125 mm

Rate = 0.8 = 0.08 + per min = +4.8 secs per hour

Watch Shield tests.

Took following tests of the shielding effect of two small leather cased sheet iron guards 5.8 cms in diam 1.2 cms + 0.7 cms deep constructed on the bridge principle.
Watch # 3,013,719 Elgin movement steel hair spring was used in this test.

1st Took chronographic rate of watch during 10 mins before exposing it to field. This rate see diagram 1 is apparently just the clock rate within limits of observation. Time 9 21/25.

2nd Watch put in glass lift cam ~~movement~~ in guard and guard in field. Second hand 5 9° = 0.8r

Watch left in field 10 mins = 5 + 9 25/25 = 2.5 = 100 secs
Field produced by energy

3rd Watch removed from field and from shield. Rate tested 9 25/25 = 0.65 mm

Rate = 0.65/10 = 0.065 per min = 3.9 sec gain per hour.
See diagram #2.

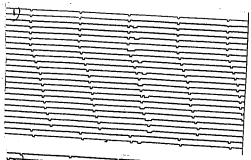
4th Lowered field. Current Tam 73°.
Throw 3 ÷ 2 = 1.5
Watch left in field 10 mins 5 ÷ 2 = 100 secs
Throw

5th Watch removed from field + shield + rate tested 10 15/50 = 0.25 mm

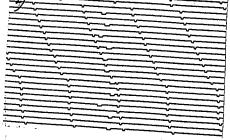
Rate = 0.8 = 0.08 + per min = +4.8 secs per hour

effect
ion guard
deep
pl.
steel
et.
metal
t to field.
quantity
limits of
guard
o.8r
.5 = 100 c.p.s
9.25 0.63
in per hour.
3.
÷ 2 = 100 c.p.s
field 125

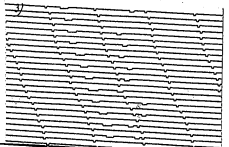
1)



2)



3)



Watch Shield tests.

Took following tests of the shielding effect of two small leather cased sheet iron guards. 5.8 cms in diam. 1.2 cms + 0.7 cms deep constructed on the bristol principle. Watch # 3,073,719 Elgin movement steel hair spring was used in this test.

1st Took chronographic rate of watch during 10 min before exposing it to field. This rate see diagram 1 is apparently just the clock rate within limits of observation. Twice 9.21.

2nd Watch put in guard and guard in field. ^ Second hand 5.9° = 0.8'.

Watch left in field 10 min 9.$\frac{29}{31}$

Field produced by energy = 5÷2 = 2.5 = $\frac{200}{\text{cms}}$

3rd Watch removed from field and from shield. Rate tested. 9.$\frac{29}{31}$ $\frac{\text{#63}}{\text{min}}$

Rate = $\frac{0.65}{10}$ = 0.065' per min = 3.9 sec gain per hour.

See diagram #2.

4th Increased Field. Reversing Tam. 7.3°.

Throw 3÷2 = 1.5

Watch left in field 10 min 10.$\frac{\text{sec}}{\text{min}}$ throw 5÷2 = $\frac{100 \text{ cms}}{\text{min}}$

5th Watch removed from field + shield $\frac{125}{\text{min}}$

+ rate tested 10.$\frac{4}{50}$.

Rate = $\frac{0.8}{10}$ = 0.08 + per min = +4.8 gain per hour.

See diagram #3.

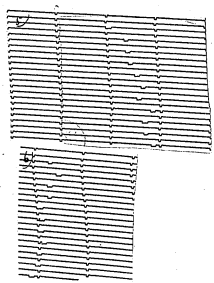
5th Increased field. Rising tam. 8°.15'

Throw 9÷2 = 4

Watch left in field increased 10 min 10.$\frac{29}{33}$

Throw 15.5÷2 = 7.75 watch in field = $\frac{310}{\text{min}}$ cms

Watch stopped. How + min hands did not work after



6th. 10.54 Watch removed from field shield.
Rate checked = Gain 168·0 sec = 0·05 per min
= 1400 sec per hour.
Watch located by compass needle + found to be distinctly magnetic + more so than shield. See diagram ⅔.

7th Watch rate being now hopelessly affected.
Tested the protective power of a similar new shield alone, measuring with the field searcher the throw outside + inside.

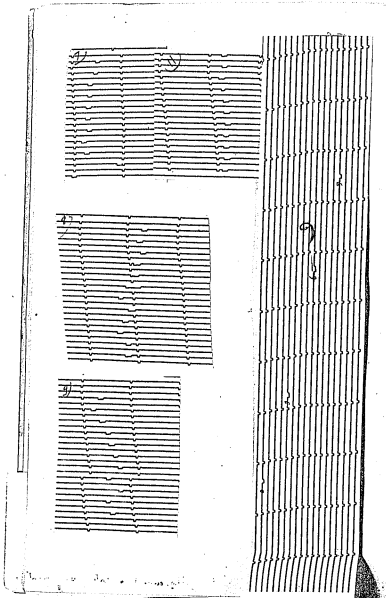
11·20 Def. 46° Summer Tem. Throw outside shield
2 ÷ 2 = 1
Inside shield Throw 3·0
2 ÷ 2.

·25 Def. 59° Summer Tem.
Throw outside 4 ÷ 2 = 2
Inside shield 3 ÷ 2 = 1.5 6·3

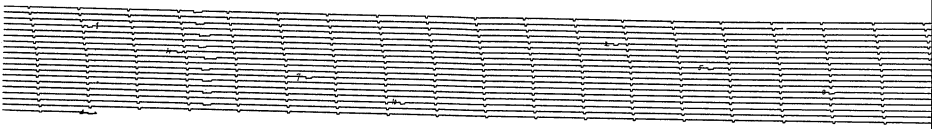
·32 Def. 73°. Summer Tem.
Throw outside 5·5 ÷ 2 = 2·75
Throw inside 3·5 ÷ 2 = 1·75 12·6

·44 Def. 8°·15' Ring Lane
Throw outside 10 ÷ 2 = 5
Inside 8 ÷ 2 = 4 31·5

8th 12·15 Tried watch rate again before demagnetising it.
Loss in ten min 0·9 sec = 5·4 sec. per hour
Evidently after running for a few hours the watch had changed its rate from rapid gain to a slight loss.



9 10 Watch now demagnetised by exposure (10)
15.15 to field of solenoid carrying alternating current
15.29. Watch exposed to field again.
Current 46° Sunrise Tan.
Throw in the field 3.25? ÷ 2 = 1.63
16.00 Watch removed from field.
Rate 0.5 gain in 10 min = 3.0 secs per hour. #6.
16.$\frac{12}{20}$ Watch again exposed to magnetic field
Current 57° Sunrise Tan.
Throw in the field $\frac{2+5+4}{3}$ ÷ 2 = 3.7 ÷ 2 = 1.85
16.23 Rate compared.
Gain 0.6 in 10 min = 3.6 secs per hour. #7
16.$\frac{37}{47}$ Watch again exposed to field
Watch stopped
Current 73° Sunrise Tan.
Throw $\frac{4+6}{2}$ = 5 ÷ 2 = 2.5
16.47 Watch removed + rate taken.
$\frac{16.50}{17.00}$ Rate 0.6 in 10 min = 3.6 secs per hour #8
17.$\frac{00}{14}$ Watch again exposed to field
Watch stopped.
Ring galv. 8.15
Throw 13 ÷ 2 = 6.5
17.$\frac{15}{25}$ Rate compared
Loss 0.25 secs in 10 min = 1.5 secs per hour
See diagram #9.
17.32 Watch again exposed to field
Ring galv. 15
Throw 25 ÷ 2 = 12.5
17.$\frac{45}{55}$ Rate compared
Gain 234 secs in 366 = 2300 + per hour. #10
17.58 Demagnetised watch by altg. current + rate. Then normal #11



Thursday 30th August

Physiological Experiments cont.

82. Brown setter mongrel bitch W. 33
L. 32
H. 20
Res. 11,000ω
Res. not stable
pulsation 160

20.50.

21.00 Direct current. Municipal Machine
Contact 60 secs:
Voltage 46° = 69 × 4 = 276 volts.
Dog howled and struggled until last second or two. Current 0.4 amperes increasing to 0.45.

21.01 Current off. Dog dead.
It is probable that 10 secs. less current would have saved it.
Res. after death 74,000. polarizing to 780ω.

---

82 Small black terrier bitch W. 10 lbs
L 18
H 12
Res 9700

Alternating current 60° = 82 × 7 = 574 × 1.4 = 517
300 alternations per sec:
Contact made for about one second.
Dog died immediately. A few gasps immediately after.
Res: after death 8000.

Friday 1st September.

Experiments with alternating current.

Prepared 3 voltameters as follows—

1 Drain wire 0·0035"
Length 0·23" + 0·74"

2 Drain wire 0·002"
Length 0·34" + 0·5"

3 Drain wire 0·002"
Length 0·16" + 0·17".

16·02 Alternating current turned on.
Voltmeter reading 85v = 104 − 10·4 = 93·6 volts.
through all three voltameters in series.
Three approximately equal batteries were supported over them. The solution was the same in each.

10·15. # 2 had 10 c.c. mixed gas $1·67 \times 10^{-5}$
9·30 # 3 - - - - $2·24 \times 10^{-5}$
13·00 # 1 - 8·6 - - $4·42 \times 10^{-5}$

3 took therefore 450 secs. for 10 c.c.
2 - " 495 - - 10 -
1 - " 660 - - 8·6 -

Friday 1st September.

Meter tests.

Temperature effect.

Employed the same four bottles but owing to the fracture of #3 it had to be omitted from the series. These bottles were put in the refrigerator and ice packed round them. The temperature was at first observed by means of a thermometer in each, but subsequently there appeared so much discrepancy between different ~~other~~ thermometers that only one our standard was read and the other temperatures were assumed to be the same at the same time. The thermometer was inserted through the glass stopper with its bulb half way up the liquid.

The res. is from the following table obviously higher at a lower temperature.

The current was after a few preliminary trial maintained at 0.99 × 10 mec.

The readings were taken both to true and false-zero.

After the test was complete, and it lasted from Friday morning to Saturday morning, the plates were taken out + reamalgamated after cleaning

10 mins. Motor temp held between 2.7° + 37.7°C.

Photograph	Time	Temp °C	Temp °F	Pressure cat	Bottle #1 f.z.	Bottle #1 L.z.	Bottle #2 f.z.	Bottle #2 L.z.	Bottle #4 f.z.	Bottle #4 L.z.
1	10.43	3.8	39°	700	2.64	2.74	3.68	3.74	3.87	3.91
2	11.15	2.7	37°	700	2.75	2.80	3.74	3.80	3.83	3.88
3	11.40	3.0	37½°	.	2.77	2.84	3.79	3.84	3.75	3.86
4	13.03	4.4	40°	.	2.65	2.71	3.70	3.75		3.81
5	13.27	6.1	43°	.	2.70	2.80	3.75	3.55	3.65	3.45
6	13.52	8.0	46½	.	2.76	2.55	3.57	3.27	3.43	3.22
7	14.34	12.2	54	.	2.38	2.23	3.07	2.85	2.95	2.75
8	15.10	15.0	59	.	2.24	2.07	2.73	2.52	2.77	2.49
9	15.29	16.4	61½	.	1.64	1.64	2.40	2.40	2.43	2.40
10	16.24	18.3	65	710	1.87	1.85	2.74	2.33	2.45	2.32
11	16.47	19.4	67		1.97	1.95	2.52	2.30		
12	17.05	20.5	69		1.87	1.80	2.27	2.17	2.22	2.10
13	17.33	22.5	72½		1.81	1.50	2.25	1.90	2.11	1.95
14	18.30	25.5	78°		1.68	1.68	1.97	1.80	1.97	1.80
15	19.11 9.23	25.5	78°		1.61	1.65	1.83	1.87	1.69	1.74
16	9.38	27.5	81½		1.53	1.57	1.67	1.77	1.56	1.57
17	9.46	28.8	84°		1.47	1.50	1.70	1.74	1.49	1.51
18	9.58	31.1	88°		1.40	1.43	1.59	1.55	1.40	1.42
19	10.07	33.3	92		1.34	1.38	1.44	1.48	1.28	1.30
20	10.23	36.1	97		1.25	1.29	1.21	1.34	1.21	1.24
21	10.32	37.5	99½		1.28	1.25	1.27	1.20	1.18	1.20

Saturday 1st September.

Alternating current experiments. with 3 Voltameters prepared as follows

10% Sol. H_2SO_4 c.p. Platinum wire

#1	0.003" diam.	length 0.76"
	0.003"	0.33"
#2	0.0020	0.50"
	0.0028"	0.18"
#3	0.001"	0.70
	0.001"	0.22

Same conditions as heretofore viz Condenser in cct. with alty. current machine and 3 voltameters in series the Bardew being on the terminals of the leads from ens: n:

10.40.00 Current on. Bardew 88° = 105 volts.
L −10.5
94.5 - mean

47.30 #1 filled 4 cc. after 450 sec.

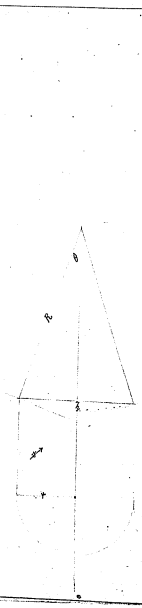
47.30 #2 " 9 " " " 450 "

47.00 #3 " 10 " " " 420 "

Made 3 voltameters of wire same diam 0.001 as follows

#1	length 0.42"	Bardew 83° = 101	
	0.23"	10	
		91 volt mean	
#2	" 0.72"	It was noticed that #1	
	0.52"	which liberated most rapidly	
#3	" 0.70"	appeared to form a plate of	
	0.22"	iron apparently by ordinary	

#1 filled 10 c.c. in 405 sec on reversing over the interval
#2 " " " " 465 " of the second. #2 did so
#3 " " " " 525 " to a slight extent but in #3 it was hardly noticeable



Sunday 2nd September

Investigation of the exact period of oscillation of a pendulum as compared with the approximate period given in text books as $T = 2\pi\sqrt{\frac{R}{g}}$.

Let m be the bob's mass
" h " its perpendicular ascent
" R " radius of movement
" θ " angle of deflection.

The energy acquired in virtue of the ascent h is mgh and if there be no friction this equals the kinetic energy $\frac{mv^2}{2}$ at the lowest point whence $v = \sqrt{2gh}$ and this must be the velocity in the equivalent orbit. The original velocity of ascent from the deflecting impulse must also have been $v = R\Omega$ where Ω is the $\frac{d\theta}{dt}$ at time 0.

Consequently equating the energy in the circle R and that in h we have $\frac{1}{2} m R^2\Omega^2 = \frac{m}{2} r^2\omega^2$ where $\omega = \frac{2\pi\sqrt{g}}{T}$

$$= \frac{4\pi^2 r^2 m}{2\, T^2}$$

$$= \frac{2\pi^2 r^2 m}{T^2}$$

but from the theory of the pendulum, we know that $v^2 = R\Omega^2$

$$= \frac{g}{R} r^2 \cos^2\theta$$

$$\therefore \frac{g r^2 m}{2R \cos^2\theta} = \frac{2\pi^2 r^2 m}{T^2}$$

$$T = 2\pi \cos\theta \sqrt{\frac{R}{g}}$$

and when θ is small this takes the usual form

This is only a second approximation to what can only be expressed by an infinite series.

Diagram from ..... Engine at .....
Diameter of Cylinder ..... ; Diameter of Rod ..... ; Stroke ..... ; Clear
Date ..... 188 ; Time ..... ; End of Cylinder ..... ; Scale of Sp
Boiler Gauge 60 ; Vacuum Gauge ..... ; Rev. per minute

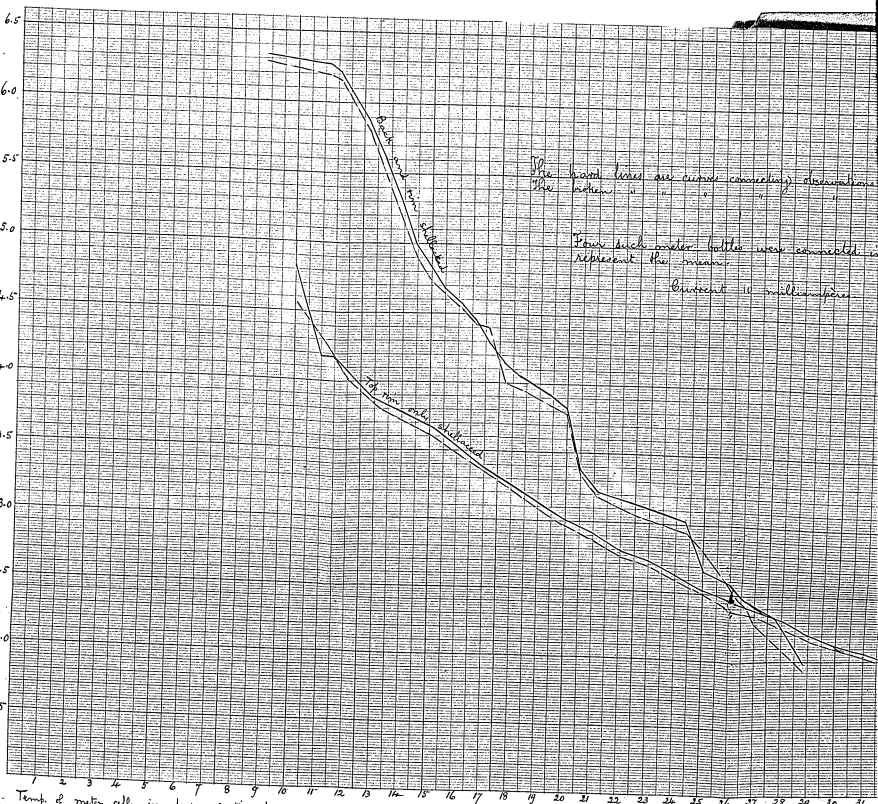
B

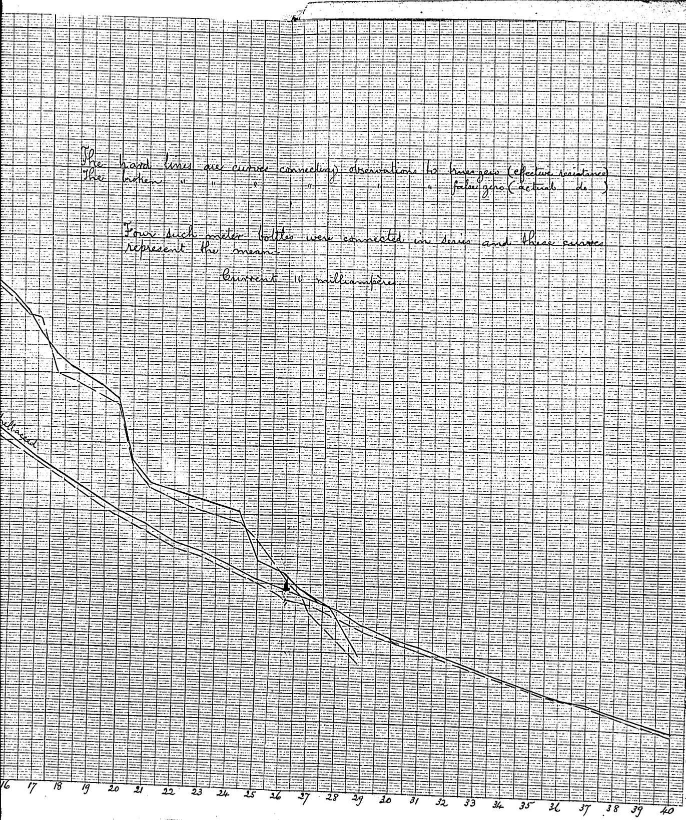
Diagram from ..... Engine at .....
Diameter of Cylinder ..... ; Diameter of Rod ..... ; Stroke ..... ; Clea
Date ..... 188 ; Time ..... ; End of Cylinder ..... ; Scale of S
Boiler Gauge 60 ; Vacuum Gauge ..... ; Rev. per minu

F

Indicator Diagrams of Phonograph Factory (17)
Engine. taken Friday 1st September

Particulars of engine
Diam: of Cylinder 16"
Area . piston 201.06 sq. in.
Diam: piston rod 2½"
Area of do. 4.9 sq. in.
Stroke 3'. 6".
Revolutions per min 85
Back Constant $\frac{201.06 \times 3.5}{33,000} = 2.132 \times 10^{-2}$
Front Constant $\frac{196.16 \times 3.5}{33,000} = 2.08 \times 10^{-2}$
$2.132 \times 85 = 1.81$
$2.08 \times 85 = 1.77$
Back end of Cylinder . Spring 30
Boiler gauge 60 . Revs: 85.
Mean pressure 3.7 lbs.
I. H.P. 6.7
Front end of Cylinder . Spring 40
Boiler gauge 60.
Mean pressure 5.3 lbs. 9.4
Total I. H. P. 16.1


The hard lines are curves connecting observations
The medium " " " " " "
Four inch under bottle were connected in
represent the mean
Current 10 milliamperes
Back and forth soldered
Top from rods soldered
Ohms. Resistance
Temp. of meter cell in degrees antigrade.



Monday 3rd Se

Trials of New Phonograph

11.30 Used smaller sized Gre
#18 solution 5% zinc:
Revolutions of new model 13

Condition	Revs per min	P.D. on terminals
Running light	136	1.556
Turning off 8th circle	132	1.542
Turning off 1/4 circle	126	1.530
Motor #2		
Running light	132	1.632
Turning off 1/8th circle	128	1.604
Turning off 1/4 circle	128	1.60[illegible]

Measured EMF and
Hussey cell.

mean EMF 1.42 volts
I. R. 0.35 ω.

6.5

6.0

5.5

5.0

4.5

Monday 3rd September.

Trials of New Phonograph motors.

11.20 Used smaller sized Grenet cell

#18 solution 5% zinc.

Revolutions of new model 136 per min. full speed

Condition	Revs. per min	P.D. in terminals	Mean Amps	Amperes	Watts.
Running light	136	1.556	0.31		
Turning off 1/16 each	132	1.542	0.335		
Turning off 1/8 each	126	1.530	0.355		
Motor #2					
Running light	132	1.632	0.30		
Turning off 1/16 each	128	1.604	0.325		
Turning off 1/8 each	128	1.602	0.34		

Measured EMF and Rs of two Hussey cell.

new EMF 1.42 volts

I.R. 0.35 ω

	Res. from cells	
F.Z.	T.Z.	F.Z.
1.83	2.070	1.83
2.21	2.49	2.52
2.22	2.50	2.33
2.24	2.50	2.33
2.26	2.50	2.32
2.27	2.52	2.35
2.28	2.52	2.35
2.28	2.52	2.35
2.29	2.52	2.35
2.28	2.51	2.34
2.26	2.48	2.31
2.23	2.46	2.20
2.19	2.40	2.20
2.16	2.36	2.20
2.10	2.31	2.14
2.00	2.22	2.05
1.95	2.13	1.98
1.85	2.06	1.89
1.77	1.97	1.80
1.66	1.84	1.69
1.57	1.76	1.60
1.50	1.68	1.51

Meter Experiments cont'd.

(19)

Took res: of four bottles separately with 99 mm.

Time	Temp bottles	Temp air	Temp Bridge	Res Bottle 1	Res of #2	Res #3	Res #4	Res in cat.
8.16	23°C	22.7°C	22°C	f.z. 7.99ω Z. 2.00ω	2.00ω 2.02ω	7.95ω 1.95ω	1.95ω 1.95ω	47ω

Res: of these commenced at 2.33ω and fell steadily to above. Connected these to cells in series. Res. leads 0.67ω

Bridge Ratio 100/1

Time	Res. in cat	Mag:	Temp Bridge	Temp of bottles	Res. lead	Res. to f.z.	d. res leads	Res to f.z.	d. res leads
8.30	40	100	22°C	23°C	0.67	7.97ω	7.3	8.00ω	7.33
.35	7100	1				9.50ω	8.83	10.75ω	10.08
.37	3450	2				9.55	8.88	10.00ω	9.33
.40	2250	3				9.63	8.96	10.00	9.33
.42	1750	4				9.69	9.02	9.98	9.31
.44	1450	5				9.73	9.06	10.06	9.39
.46	1255	6				9.80	9.13	10.06	9.39
.47	1090	7				9.80	9.13	10.07	9.40
.49	875	8				9.81	9.14	10.07	9.40
.51	690	10				9.80	9.13	10.03	9.36
.53	440	15				9.70	9.03	9.92	9.25
.55	315	20				9.58	8.91	9.75	9.18
.58	247	25				9.48	8.81	9.61	8.94
9.00	200	30				9.29	8.62	9.45	8.78
.02	145	40				9.05	8.38	9.22	8.55
.06	117	50				8.68	8.01	8.86	8.19
.07	94	60				8.47	7.80	8.60	7.93
.09	65	80				8.08	7.41	8.23	7.56
.10	45	100				7.75	7.07	7.88	7.21
.12	23	150				7.30	6.62	7.43	6.76
.13	11	200				6.93	6.26	7.05	6.38
.15	4	250				6.60	5.97	6.72	6.05

Meter Tests continued.

Temp. test 4 cells in series.
Set cells bottle in mixture of ice and salt and brought the temp. of their solution down to 0°C but this had risen to 1·10°C before connection could be made.

	F.Z. One Cell	T.Z One Cell
	4.57	4.85
	4.31	4.18
	4.18	4.18
	4.11	4.08
	3.84	3.87
	3.72	3.78
	3.62	3.68
	3.48	3.53
	3.36	3.38
	3.22	3.26
	3.08	3.13
	2.97	3.01
	2.87	2.92
	2.75	2.79
	2.68	2.72
	2.60	2.64
	2.50	2.53
	2.39	2.46
	2.34	2.39
	2.25	2.31
	2.16	2.20
	2.09	2.12
	2.03	2.06
	1.96	1.98
	1.90	1.91
	1.83	1.85
	1.77	1.78
	1.68	1.72
	1.62	1.68
	1.60	1.61
	1.53	1.54
	1.48	1.50

Time	T.B.	Bridge Ratio	Res. in ects	Mod	Mod.	Temp. cell	Res. F.Z.	Res. T.Z.	Leads	F.Z	T.Z.
13.56	22.70	1000/10	690	10	Radio	10°C	18.75ω	18.00ω	0.67ω	18.08	17.33
14.00				10		11	17.90	17.40		17.23	16.73
·02				15		11.5	17.20	17.40		16.53	16.73
·05						12	16.70	17.00		16.03	16.33
·08						13	16.02	16.13		15.35	15.46
·10						14	15.55	15.80		14.88	15.13
·12						15	15.17	15.37		14.50	14.70
·14						16	14.60	14.80		13.93	14.13
·16						17	14.10	14.20		13.43	13.53
·19						18	13.55	13.70		12.88	13.03
·21						19	13.00	13.20		12.33	12.53
·23						20	12.55	12.72		11.88	12.05
·25						21	12.14	12.34		11.47	11.67
·27						22	11.67	11.94		11.00	11.17
·29						23	11.38	11.55		10.71	10.88
·31						24	11.08	11.23		10.41	10.56
·33						25	10.65	10.80		9.98	10.13
·35						26	10.22	10.32		9.55	9.65
·37			700		Resonance	27	10.03	10.23		9.36	9.56
·40						28	9.65	9.90		8.98	9.23
·42						29	9.30	9.47		8.63	8.80
·45						30	9.01	9.16		8.34	8.49
·49						31	8.77	8.92		8.10	8.25
·51						32	8.50	8.60		7.83	7.93
·54						33	8.25	8.32		7.58	7.65
·56						34	7.97	8.05		7.30	7.38
·59						35	7.74	7.80		7.07	7.13
15.01						36	7.52	7.56		6.85	6.89
·04						37	7.31	7.36		6.64	6.71
·07						38	7.05	7.12		6.38	6.45
·11						39	6.80	6.88		6.13	6.21
·14						40	6.60	6.65		5.93	5.98

The area of the exposed surface on one of these 25 light plates is

			sq. cm.
	$2 \times 2.5 \times 7.6$	=	38
+	$2 \times 7.6 \times 0.6$		9.12
+	$1 \times 2.5 \times 0.6$		1.5
	Total.		48.62

Thinking that most of this surface was called into comparatively small activity, shelled the rim and outer faces of all the 8 plates and replaced them, thus leaving just 19 sq. cms. of surface or reducing the area 2.5 times.

F. Z. Cm. Cell	T. Z. Cm. Cell
4.83	5.08
4.77	4.96
4.66	4.91
4.65	4.82
4.50	4.66
4.42	4.58
4.26	4.67
4.16	4.33
4.26	4.11
4.03	4.13
3.53	3.63
3.31	3.47
3.11	3.21
2.91	2.96
2.68	2.73
2.53	2.60
2.41	2.46
2.25	2.30
2.14	2.20
1.99	2.05
1.89	1.94
1.80	1.86

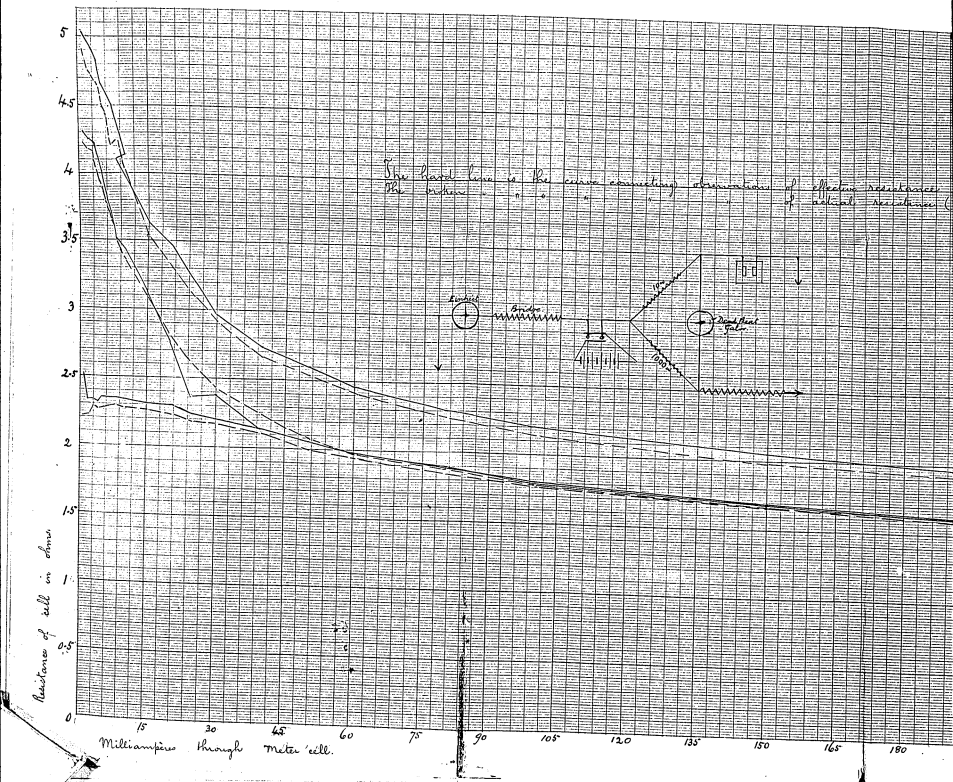
Time	T. Cell	Ratio Body	Resist. cel.	Mes.	Discg. Key F.Z.	T.Z.	Leads	F Z.	T. Z.	Ratio to Leads
6.30	21.5°	1000/10	7300	1	24.00	24.80	0.67	19.33	20.13	
.33			3570	2	19.75	20.50		19.08	19.83	
.35			2260	3	19.45	20.30		18.78	19.63	
.37			1710	4	19.25	19.95		18.58	19.28	
.40			1450	5	18.65	19.20		17.98	18.63	
.42			1185	6	18.35	19.00		17.68	18.33	
.44			995	7	17.70	18.35		17.03	17.68	
.46			1000	7	17.30	18.00		16.63	17.33	
.47			880	8	17.70	17.10		17.03	16.43	
.48	22.		680	10	16.80	17.20	–	16.13	16.53	
.49			440	15	16.80	15.20		16.13	14.53	
.51			311	20	13.90	14.35		13.23	13.78	
.52			240	25	13.10	13.52		12.43	12.85	
.55			192	30	12.30	12.50		11.63	11.83	
7.00			150	40	11.37	11.60		10.70	10.93	
.02			114	50	10.80	11.05		10.13	10.38	
.03			92	60	10.30	10.50		9.63	9.83	
.05			62	80	9.65	9.88		8.98	9.21	
.06			44	100	9.22	9.42		8.55	8.81	
.08			21	150	8.64	8.85		7.97	8.18	
.09			10	200	8.21	8.44		7.54	7.77	
.10			3	250	7.85	8.10		7.18	7.43	

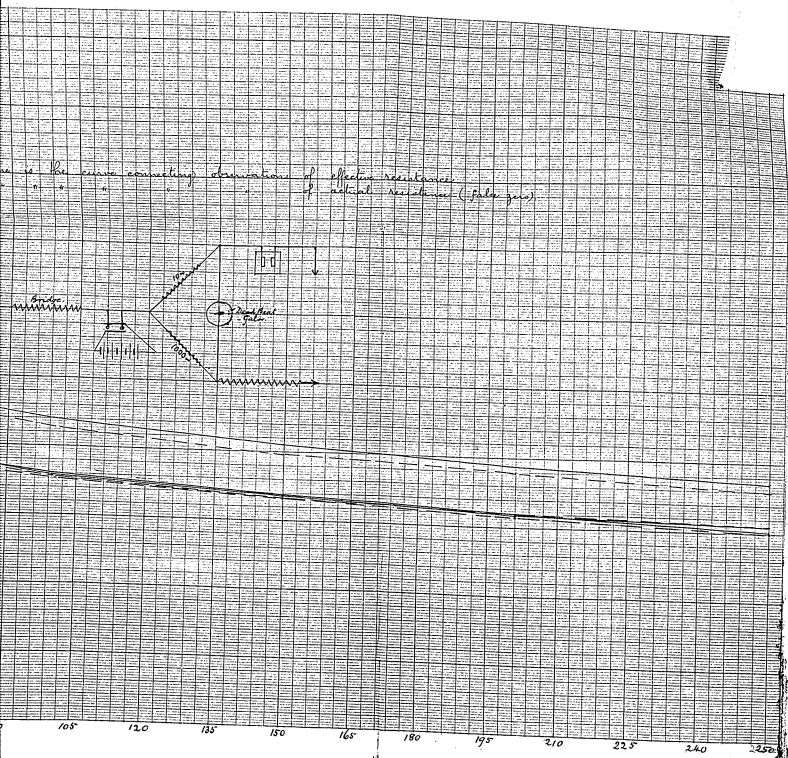
Cons. Coll. F. 2.	Cons. Coll. T. 2.
6.28	6.33
6.20	6.28
6.15	6.22
5.80	5.88
5.44	5.60
5.19	5.29
4.90	5.00
4.73	4.83
4.65	4.68
4.53	4.58
4.42	4.46
4.40	4.28
4.00	4.13
3.76	4.05
3.86	3.93
3.79	3.83
3.23	3.38
3.18	3.23
3.08	3.12
2.95	3.03
2.80	2.67
2.51	2.56
2.48	2.46
2.28	2.32
1.93	1.98

Temperature test.
L^18 Sept: 1888

L bottles in series as before each plate 19, sp. cons.

Time	T.B.	Bright Rate	Res. in cat.	Mar.	Temp. (Cat)	Res. F.2.	Res. T.2.	Leak	Res. F.2.	Res. T.2.	Rate
10.20		100%/10	7.30	10	8.8°C	25.20	25.40	0.09	25.11	25.31	
.22				8	11.10	26.90	25.20		26.81	25.11	
.30					11.6	24.70	24.95		24.61	24.86	
.36					12.7	23.30	23.60		23.31	23.51	
.45					13.3	21.85	22.50		21.76	22.41	
.55					13.8	20.85	21.25		20.75	21.16	
10.08					14.4	19.69	20.10		19.60	20.01	
.18					15.0	19.00	19.39		18.91	19.30	
.25					15.5	18.47	18.82		18.38	18.73	
.30					16.1	18.20	18.40		18.11	18.31	
.43					16.6	17.77	17.92		17.68	17.83	
.51					17.2	16.76	17.22		16.61	17.13	
11.00					17.7	16.65	17.17	0.04	15.98	16.50	
.02					18.3	16.30	16.85		15.83	16.18	
.05					[illegible]						
					19.4	16.05	16.40		15.38	15.73	
.10					20.0	15.82	15.97		15.15	15.30	
.20					20.5	14.00	14.17		13.33	13.50	
.23					21.1	13.40	13.50		12.73	12.87	
.26					22.7	12.84	13.15		12.77	12.48	
.32					24.4	12.60	12.77		11.78	12.10	
.43					25.0	11.90	11.35		11.23	10.68	
.50					24.1	10.90	10.90		10.03	10.23	
.53					26.6	10.30	10.50		9.63	9.83	
.58					27.7	9.60	9.99		9.13	9.32	
12.02					28.8	8.40	8.60		7.73	7.93	


The heavy line is the curve connecting observations of effective resistance
The other " " " " " of actual resistance
Battery
Bridge
Dead beat galv.
Resistance of cell in ohms
Milliamperes through Meter cell.
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
15
30
45
60
75
90
105
120
135
150
165
180



Alternat

Monday 3rd Septem

3 Voltameter

Rough measurem

No.	Time	Diam. wire inches	Diam. de. cms	
I	9.20–9.50 30 hours	0.001 0.001	0.0025 0.0025	
II	9.21–9.51 30 hours	0.001 0.001	0.0025 0.0025	
III	9.21–9.51 30 hours	0.001 0.001	0.0025 0.0025	

The quantity

$2 n E_{max} k^t \times 10^{-7}$

where n = n

E = "

k =

Each of decomposes

$= 1.039 \times 10^{-4} \times 1.$

that means el

∴ the formula be

$V = 3.456$

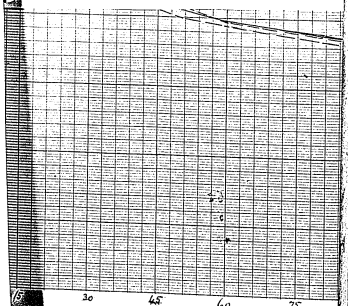
$= 3.456 \times$

$= 5.43 E$

$5.43 \times 2.84 =$

$15.42 \times 1.933 =$

$5.43 \times 2.675 =$



Through Meter cell.

Monday 3rd September

3 Voltameter in series as in last test.
(Rough measurement of volume only)

No.	Time	Diam. with tube	Diam. de. cm.	Length tube	Length cm.	Area Cathode	Vol. gas c.c.	Effect. Resistance	alt. per sec.	Volts	Amps
I	9.21–9.30 360 sec	0.001 0.001	0.0025 0.0025	0.042 0.042	0.602 0.602	83×10^{-5} 47×10^{-5}	10.5	1450	193.3	105	B
II	9.21–9.27 360 sec	0.001 0.001	0.0025 0.0025	0.53 0.76	1.23 1.91	1.3×10^{-3} 1.09×10^{-3} 1.20×10^{-3}	9.0	-	-	-	B
III	9.21–9.27 360 sec	0.001 0.001	0.0025 0.0025	0.22 0.64	0.58 0.60	2.54×10^{-3} 2.33×10^{-3} 2.43×10^{-3}	9.5	-	-	-	B

The quantity passing through the circuit is

$2\,n\,E_m\,kt \times 10^{-7}$ abs. qs.

where n = no. of alternations per sec. Here 193.3

E = maximum voltage 105

k = capacity in microfarads 2.96

Each of decomposes 0.0001038 gramme H.

$= 1.037 \times 10^{-4} \times 1.11 \times 10^{4}$ c.c. $= 1.1522$ c.c. at 0° H

that means also half as much O $= 0.5764$ " " 0° O

mixed gases 1.7983 " "

∴ the formula becomes

$V = 3.456\, n\, E_m\, kt \times 10^{-7}$

$= 3.456 \times 1.5708 \times n\, E_m\, kt \times 10^{-7}$ c.c.

$= 5.43\, E_m\, nkt \times 10^{-7}$ c.c.

$5.43 \times 2.84 = 15.42$ Constant

$15.42 \times 1.938 = 29.81$

$5.43 \times 2.675 = 14.53$

	F.Z. One Cell	T.Z. One Cell
1	4.28	4.31
2	4.18	4.26
3	4.16	4.21
4	4.03	4.11
5	3.91	4.01
6	3.78	3.81
8	3.63	3.71
8	3.51	3.51
10	3.37	3.43
15	3.10	3.13
20	2.80	2.76
25	2.62	2.86
30	2.43	2.38
40	2.25	2.13
50	2.08	2.02
60	1.97	1.99
80	1.88	1.86
100	1.78	1.79
150	1.67	1.68
[illegible]	1.60	1.59
210	1.55	1.55

Meter tests Continued

4th September 1888.

Scraped off the shellac varnish from the edge of the plates increasing area of surface on each to 29.6 sq. cms, and repeated current test as follows:— 4 cells in series

Time	T.B.	Bridge Ratio	T. cells	Res. in ohms	Mec.	F.Z. Ext.	T.Z. Ext.	Leads	F.Z.	T.Z.
15.57	25.6	100/p.	25.5°C	7350	1	17.60	17.90	0.67	16.93	17.23
16.00				3580	2	17.40	17.70	1.	16.73	17.03
16.03				2300	3	17.30	17.50	"	16.63	16.83
16.07				1700	4	16.80	17.10	"	16.13	16.43
16.09				1450	5	16.30	16.70	"	15.63	16.03
16.11				1203	6	15.70	15.90	"	15.03	15.23
16.15				1030	7	15.20	15.50	"	14.53	14.83
16.17				895	8	14.70	14.70	"	14.03	14.03
16.20				695	10	14.15	14.40	"	13.48	13.73
16.38				450	15	13.05	13.20	"	12.38	12.53
16.45				325	20	11.85	11.70	"	11.18	11.03
16.52				250	25	11.05	10.10	"	10.45	9.43
16.55				202	30	10.40	10.17	"	9.73	9.50
16.58				140	40	9.65	9.20	"	8.91	8.53
17.03				115	50	899	894	"	8.32	8.27
17.11				92	60	855	861		7.88	7.94
17.18				64	80	820	825		7.53	7.58
17.21				45	100	777	782		7.10	7.15
17.27				22	150	736	739		6.69	6.72
17.32				11	200	705	704		6.38	6.34
17.36				4	250	685	685		6.18	6.18

Watch spring elasticity tests on
5th September 1888

Distension hole 15 cms.

3 Trials of following springs
(1) Elgin
(2) Waltham
(3) Dufour Lutz 1st quality
(4) Common swiss
(5) Paillard

The best were the Dufour Lutz Diam 0.018 cm × 0.005 of 22 spires. No visible distortion in alloy cm

2nd Waltham. Diam 0.9 cm 20 spire 0.030 cm × 0.005 cm
(1) slight distortion of outer spire
(2) do do (barely) visible
(3) No visible distortion

3rd Paillard Diam 1.05 15 spires 0.023 cm × 0.009
(1) very slight dishing
(2) 0.1 cm do
(3) 0.1 do.

4th Elgin Diam 0.8 13 spire 0.025 cm × 0.006
(1) 0.3 cm. dishing
(2) 0.2 -
(3) 1.25 -

5th Common swiss spring 0.7
(1) 3.2 cms dishing 12 spire 0.018 × 0.005
(2) 0.3 -
(3)

Removed the spring from Waltham # 3.534.804 cm #5 applied to Tracy movement alloy spring
14 spire Diam 0.8 0.025 × 0.009
Distension of 10 cms 0.75 dishing
- 15 - 4.0 -

Trial #2 heated steel spatula to red heat in blow pipe flame then dropped new spring upon it and watched for distortion.
3 hrs.

The best was the Waltham
(1) No visible distortion
(2) slight distortion
(3) very slight distortion.
Lutz + Paillard about equal

3
(1) slight distortion eccentrically
(2) very slight
(3) do. do.

2 Paillard
(1) very slight
(2) perfect
(3) very slight

4 Cheap swiss
(1) very bad distortion
(2) - - interbend.

Tested these springs for temper by distension.
15 cmo.

(1)	Lutz best	(1)	none visible	
		(2)	-	-
		(3)	-	-
(2)	Paillard	(1)	0·05	dubious
		(2)	0·2	-
		(3)	0·1	-
(3)	Waltham	(1)	0·3	-
		(2)	0·2	-
		(3)	0·8	-

(4) Cheap swiss not necessary to try

Thursday 6th September

Multipolar Converter ready for winding

Used two coils for winding

5 lbs of #24 BWG 0·022"

11½ . . #18 B&S 0·040"

3 turns of the fine wire carried 9 layers.

= 27 turns x $\frac{240}{6}$ = 1080 convolutions per sector

+ 1 turn of the coarse wire in 3 layers

carried by - - - - - - 3 layers

= 3 double turns per block = 120 double turns per sector.

Alternating Current Electrolysis.

3rd September.

Tried 3 voltameters again in series as before gradually shortening the wire. 10% H_2SO_4 c.p. wt.

193·5 alts per sec.

No. of cell	Time	Secs. of current	Diameter inches	Diameter cms.	Length inches	Length cms.	Gas developed c.c.	Voltmeter Rdg.	Voltmeter volts	Ammeter Rdg.	Ammeter amps.	Cell vol.	Remarks
I	10·15 - 21·30	390	0·001	2·5×10⁻²	0·42 0·24	1·05 0·602	10·9	93	113	1·		13·44	Slight condensation on evolved by globules of liquid on surface of glass.
II	10·15 - 21·30	390	"	"	0·53 0·76	1·33 1·91	9·2	"	"			13·44	
III	10·15 - 21·30	390	"	"	0·22 0·264	0·552 0·660	12·0	"	"			13·44	

Constant 1·5442 × 1·933 = 2·981 Vol. Dog. Const.

Repeated experiment with still finer wire.

No. of cell	Time	Secs. of current	Diameter in.	Diameter cms.	Length in.	Length cms.	Gas developed	Voltmeter Rdg.	Voltmeter Mean	Ammeter Amps.	Cell vol.	Remarks
I	11·25 - 21·30	390	0·001	2·5×10⁻²	0·42 0·264	1·05 0·602	9·5	96	115		13·37	
II	11·25 - 21·30	"	"	"	0·13 0·11	0·33 0·28	12·8	"	"			
III	11·25 - 21·30	"	"	"	0·22 0·264	0·55 0·66	12·5	"	"			

Repeated experiment with still finer wire.

No. of cell	Time	Secs. of current	Diameter in.	Diameter cms.	Length in.	Length cms.	Gas developed	Voltmeter Rdg.	Voltmeter Mean	Ammeter Amps.	Cell vol.	Remarks
I	16·8·30 - 11·25	195	0·001	2·5×10⁻²	0·05 0·10	0·126 0·257	3·5	96	106		3·56	16·5 alts but corr. reduced to 1·6440 of 1·6440
II	"	"	"	"	0·05 0·05	0·126 0·126	3·5					
III	"	"	"	"	0·10 0·13	0·257 0·328	3·5					

Found Condenser to have imperfect insulation (the lowest has been on a very damp day) 201,000Ω on a dry day about 1M. The capacity of it was therefore difficult to measure accurately).

The best value is as follows:—

The armature marked	4	0.104
" " "	8	0.187
" " "	16	0.430
" " "	32	0.875
" " "	64	1.045
	Sum	2.641
	Measured total	2.675

Cell No.	T. time	Spec. gr. of solvent	atm. p. Mult. factor	Strength In.	Strength Cm.	Depth In.	Depth Cm.	Gas Analysis	Orientation Rdg.	Orientation Mean	Area Sq. cm	P.D. Volts	
I	16.56	2.60	693.3	0.02	0.051	0.001	2.540³	g	98°				
	17.00			0.10	0.251								
II	3.9.88			0.05	0.126	"	"		11.5°				
				0.05	0.126								
III				0.10	0.251	"	"		11.75				
				0.10	0.251								

Same experiment = continued 4th Sept. 88.

One single pair of wires fixed in the sake of insulating material were gradually reduced in length all other conditions maintained constant. The solution was 10% H_2SO_4 in distilled water. The results are shewn.

Calibrated a glass tube of about 0.4 cm. internal diameter by means of a (burettes reading) to $\frac{1}{100}$th c.c.

Observed that with 5.5 cms in tube Burette reading = 26.5

$\frac{12.4}{6.9}$ . . . equivalent to $\frac{27.25}{0.75}$ cm.

so that 1 cm = $\frac{.75}{69}$ = 0.1087 c.c.

Revs. of dynamo 11433 =

$\frac{8}{60} \times 11433$ atts per sec = 191 per sec.

Capacity 2.675 f

Constant = $5.43 \times 2.675 \times 1.91 \times 10^{6} \times$ time $\times$ volts mean $\times 10^{-7}$

$= 2.775 \times t \times E \times 10^{3}$

Section added to mean

No.	Time	Capacity cu. ft.	Volts per revolution	Diameter wire in.	Diameter wire cm.	Length in.	Length cm.	Area sq. cm.	Length tube	Vol. displ.	Calculated volume
I	14.45.00 14.45.45 45 secs.	76°	89.5	0.001	2.5154	0.75 0.72	1.907 1.827	1.2354×10^{-3} 1.2354×10^{-3}	8.3	0.901	1.118
II	15.07.00 07.45 45 secs.	95°	89.1	"	"	0.48 0.50	1.205 1.255	0.7854×10^{-3} 0.7854×10^{-3}	9.3	1.010	1.113
III	15.23.00 23.45 45	75°	89.1	"	"	0.14 0.17	0.351 0.427	2.776×10^{-3} 3.3×10^{-3}	9.6	1.040	1.113
IV	15.33.00 33.45 45 secs.	75°	89.1	-	-	0.10 0.11	0.251 0.276	1.97×10^{-3} 2.18×10^{-3}	10.4	1.13	1.113
V		80°	92.25			0.04 0.07	0.100 0.176	7.9×10^{-4} 1.39×10^{-3}	expanding	removed.	
VI	16.13.00 16.00 60 secs.	80°	92.25	0.0014	0.018	0.66 0.63	1.66 1.58	5.2×10^{-3} 4.9×10^{-3}	11.1	1.205	1.536
VII	16.23.00 23.50 50 secs.	78°	90.8	"	"	0.38 0.38	0.952 0.952	3.0×10^{-3} 3.0×10^{-3}	9.95	1.080	1.260
VIII	16.33.00 33.50 50 secs.	77°	90	"	-	0.22 0.22	0.551 0.551	1.72×10^{-3} 1.72×10^{-3}	9.5	1.032	1.249
IX	16.43.00 44.00 60 secs	80°	92.25	-	-	0.13 0.11	0.326 0.276	1.018×10^{-3} 0.8639×10^{-3}	11.7	1.271	1.536
X	16.53.00 53.45 45 secs	79°	91.35	-	-	0.06 0.06	0.151 0.151	5.51×10^{-4} 5.51×10^{-4}	9.75	1.059	1.140
XI	17.03.00	80°	92.25	-	-	0.04 0.03	0.10 0.075		expanding	removed	

As it was evident from the smell of the gas and apparently also from the globules of water on the inside of the tube that ozone was developed and that this vitiated the results experimented on the use of sodium hyposulphite $Na_2S_2O_3$

Prepared a solution of 10% pure H_2SO_4 in distilled water and added to this the $Na_2S_2O_3$ in small quantities. Discovered however that a reaction took place viz

$$H_2SO_4 + Na_2S_2O_3 = Na_2S_2O_4 + S + SO_2 + H_2O$$

by which a gas was formed and sulphur precipitated. The results obtained with this solution were therefore rejected.

A new solution was then made up of pure water. The evaporating dish diam. 11.2 cms held this to 4.3 cms depth = 423.7 c.c. or 423.7 grammes.

Monday) 10th September

Experiment with meter continued.
The four cells last experimented with were employed.
Two (nos 1 + 2) were connected up in the meter and a current of about 2·5 ampères sent through them. Two others (nos 3 + 4) were left disconnected. Before starting the resistances were

Cells No.	Time	Ri in cub.	Mast	Pur. Ind T.Z.	Pur. Ind F.Z.	Lads	Pur. Ind T.Z.	Pur. Ind F.Z.	T.Cas
1	17.10	720		2·26	2·23	0·61	1·65	1·62	77°
2	·15	100	10	2·14	2·13		1·53	1·52	
3	·18	23·2°C		3·14	3·12		2·53	2·51	
4	·20			2·61	2·59		2·00	1·98	

The next trial was on the 6th September after some 30 hours current supply.

1	9·06	750		2·57	2·57	0·61	1·96	1·96	
2	9·09	100	10	2·45	2·45		1·84	1·84	62°F
3	9·02	17·3°C		3·50	3·50		2·89	2·89	
4	9·00			5·30	5·15		4·69	4·54	

The next trial was on the 7th September

1	9.56	340		2·37	2·37	0·60	1·77	1·76	
2	·58	100	10	2·26	2·26	~~1·60~~	1·66	1·66	67°
3	10·00	19·3°C		3·49	3·44		2·89	2·84	
4	·02			5·52	5·39		4·92	4·79	

The next trial was on the 10th Sept.

Cell No	Time	Res. in cct.	Mes	T.Z. observed	F.Z. observed	Res. bridge	T.Z.	F.Z.	Temp. cell
1	9.20	700 ω	-	2.23	2.20	0.60	1.63	1.60	71°F
2		1000/10	10	2.23	2.21		1.63	1.61	
3		"		3.40	3.37		2.80	2.77	
4		"		7.40	7.00		6.80	6.40	

The two cells that have hitherto taken current have now been cut off and disconnected while the two hitherto disconnected were now put into metre + current pass.

Next test after 24 hours on the 11th Sept.

Cell No	Time	Res. in cct.	Mes	T.Z.	F.Z.	Res. bridge	T.Z.	F.Z.	Temp. cell
1	8.00	690	.	2.80	2.74	0.60	2.20	2.14	
2		1000/10	10	2.67	2.65		2.07	2.05	72°F
3				2.37	2.37		1.77	1.77	
4		23.		2.77	2.77		2.17	2.17	

Next test after 24 hours on the 12th Sept.

Cell No	Time	Res. in cct	Mes	T.Z	F.Z.	Res. bridge	T.Z.	F.Z	Temp. cell
1	9.50	620	10	2.65	2.60	0.60	2.05	2.00	
2		630		2.82	2.77		2.22	2.17	69°F
3				2.43	2.38		1.83	1.78	
4				2.63	2.55		2.03	1.95	

Calculation for the Correction of the Temp. & oxide errors in meters.

1st By changing the size of the spool from 6 to 4
2nd " altering the res. of the spools as well
3rd " " " shunt.

If the current passing through the meter be . C
" " " " " cell " c
" " resistance of the shunt be s
" " " " " spool be r
" " " " " bottle b

Then $c = \frac{Cs}{b+r+s}$

Also if we decide that an alteration of res. under any circumstances of ~~a~~ u in the bottle shall not produce a change of current exceeding x per cent in the ~~cell~~ bottle we have

$$100 \times \frac{\frac{Cs}{b+r+s+y}}{\frac{Cs}{b+r+s}} = 100 - x$$

$$\therefore 100(b+r+s) = (100-x)(b+r+s+y)$$

$$\therefore y = \frac{x}{100-x}(b+r+s)$$

$$\text{and } x = \frac{100y}{b+r+s+y}$$

$$b = \frac{100y}{x} - (r+s+y)$$

$$r = \frac{100y}{x} - (b+s+y)$$

Here if $s = 0.01$ $r = 8$ and $b = 2$ y being 0.5
$x = 5\%$.

To make x 1% we have $r = 48.50 - (2.5) = 46.5$
" " 2% " $r = 25 - (2.5) = 22.5$

Tested the solution in the meter bottles for acidity. Took litmus test of solution in bottle 10 which had remained inactive and also of solution that had taken current for a week. No visible difference between them.

Took the weights of the idle zinc plates one of which was pure and the other 1% Hg.

10th Sept. 18. 0.

The 1%	24·0566 on 24th Aug	=	24·0752 on 10th Sept.
- 0%	23·7536 - - -	=	23·7576 - - -
Gain of 0%	0·0340		
- 1%	0·0186		

S. Dyne.

Tuesday 11th September

Compared Galvanometers.
Black fibre renewed and instrument adjusted.
Siemens Dynr. adjusted.
Gaugain Galvr. adjusted
Passed current from Main through platinoid res: and took P.D. off a certain part of it in Daniel volts, the res: being subsequently measured.

P.D. Daniel volts	Current in Amps	Siemens Tan		Gloah Deflects	Gloah Curnts	Ring		Gaugain	
1·230	1·098	83°	[7·218 / 82·19']	0·200	0·182	8°·02	[0·1288 / 7·20']	55°	[1·313 / 52·45']
		Siemens Dynr							
1·910	8·205	65°	0·8915 T_{a}	1·30	0·158	42°	[0·1798 / 8·16']		

Wednesday 12th September

Took following comparison of Galvanometers

Mr D. in Gray Light Ohm	Galv: Diff. for 0.06 water shunt	Obach crossed cut	Swinnow Ring tangent	Gaugain	Swinnow tangent	Kohlrausch Dynm.		
0.290	22	0.06						
	116.3	0.2370	13°.45					
1.477 on 1000	59.0 on 1000	0.588		8°	34°.30'	10.3 doubtful at 27 Ohm Lt.		

The current in the first instance was 0.290 amp
The next current was $\frac{290 \times 116.3}{22} = 1.533$
- Third - - 0.0014477

The Constants are therefore $\frac{59}{22} \times \frac{1}{2} \times \frac{1}{1000} = 0.0013441$

Obach Coarse	Fine	Ring tan	Gaugain Fine		Swinnow tangent Coarse	Fine	
Ten for amp 0.178	Ten for amp 0.398	Ten for amp 0.1536 8°.45		Ten for amp 0.0921 5°.26'		Ten for amp 0.2654 24°.57'	

Swinnow Dynm. gives 136°.20' for 1.915 on Obach
- Constant of $0.962\sqrt{\text{Ten}}$

Kohlrausch Dynm. gives 7°.8'.15" for 1.4477 amp.

Wednesday 12th September.

Res. of Galvanometers Temp Room 22.2 °C T.B. 21.3 C.

Obach Coarse Negligible

Fine 1000/1000 2231.5 − 0.5 = 2231 ω

Gaugain Coarse 0.031 ω (0.579 − 0.548 leads)

Fine 51.64 ω

Siemens Coarse 0.084 ω

Fine 123 ω

Kohlrausch Swinging coil + wire 105.75 ω

Fixed coil 43.91 ω

No.	Galvanometer	Coil	Res. @ 22 °C	Deflection by Tangent	Deflection by Tangent
1	Obach	coarse	0	0.180 ln	
		Fine	2231 ω		0.398
2	Ring		0	0.1405 (87)	
3	Gaugain	coarse	0.031 ω	53° (1.327)	
		fine	51.64 ω		5° 30′ 0.095
4	Siemens	coarse	0.084 ω	82° 30′ (7.661)	
			123.0 ω		25° (0.465)
5	Siemens Dynamometer			Constant	0.862 $\sqrt{\text{Tan}}$
6	Kohlrausch	swinging coil wire	105.75 ω		
		Fixed coil	43.91 ω		

Wednesday 12th September.

Storage cell test.

2 storage cells were charged some time since for experimenting on phonograph motor and had done some small amount of work. They were discharged through 1 ω the 4 HP Ergmeter.

The rate of this was − 0.87 secs per hour.

The ~~for~~ discharge commenced at

~~13~~ 9.11. 14.20. when the error by the clock was − 26

On following morning

9.12. 8.13.19 the ergmeter indicated

8.14.00 = +41 a gain of

67 secs in 17hrs 48 mins

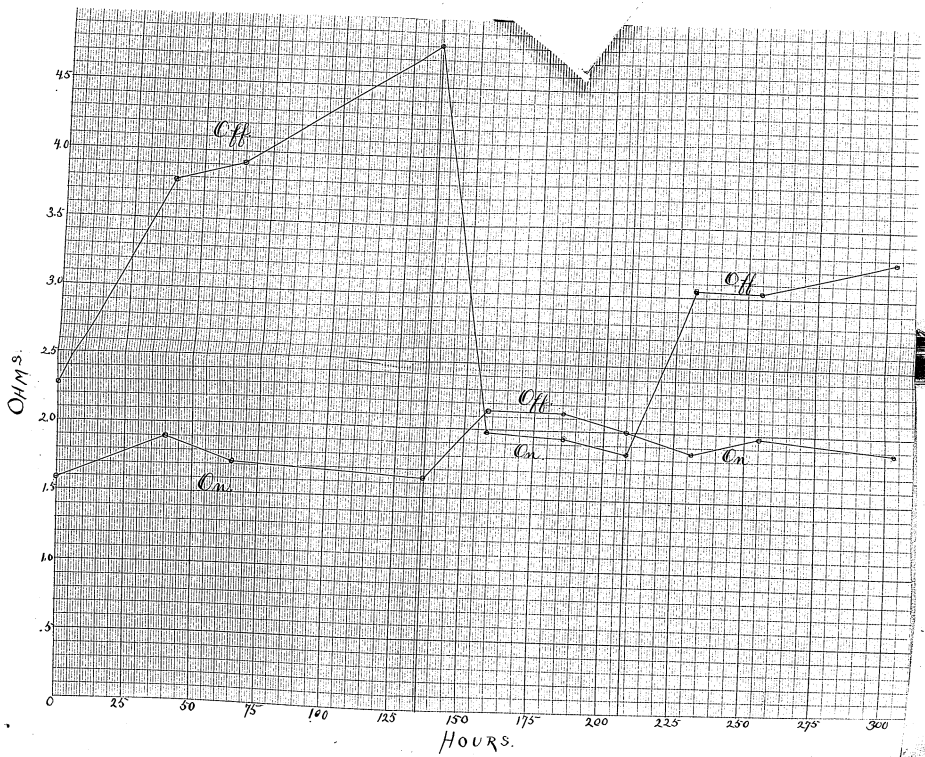
at its natural rate the ergmeter would have lost 15 secs so that the gain amounted to 82 secs

This represent by the date of the clock.

$\frac{82}{60} \times 36 \times 10^5$ Joules = 4.92×10^5 Joules

at ~~1~~ volts pressure this would be equivalent to 1.23×10^6 Coulombs this divided by 6.72×10^4

= ~~2.46~~ $\frac{123}{6.72}$ ampères = about 18 ampères.


Off
Off
Off
On
On
On
OHMS.
HOURS.
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
0
25
50
75
100
125
150
175
200
225
250
275
300

Meter tests continued. from page 33.

The next trial was after 24 hours on 13th Sept. as follows—

Cell No.	Time	Res. in cct	Mar	Obtained T.Z.	Obtained F.Z.	Res. Ind.	T.Z.	F.Z.	Temp
I	9.0	690	10	2.50	2.52	0.52	1.96	1.98	17°
II		1000/μ		2.57	2.62		2.03	2.08	
III				2.27	2.30	–	1.73	1.76	20°
IV		205.C		2.50	2.53		1.96	1.99	

Set up four 12 light bottles and 12 more 25 light bottles in series, with simple chromic acid, cleaned by dilute H_2SO_4 and N_2OH, no amalgamation and shellac on the top rim.

17.45

Series	Time	Res. in cct.	Mar	Obtained. T.Z.	Obtained. F.Z.	Lands	T.Z.	F.Z.	Temp
12	17.45	650	10	40.60	37.00	0.52	40.08	36.46	23°C
25		1000/μ					10.015	9.110	
				39.70	30.00	0.52	39.16	29.46	
							9.79	7.37	

After 24 hours

Series	Time	Res. in cct	Mar	Obtained T.Z.	Obtained F.Z.	Lands		
12	15.40	1000/μ	10.	50.00	43.00	0.52	49.96	42.46
25	13.9.89	700		50.00	43.70		49.46	43.16

Reversed the cells in the vessels but by putting 1 + 2 in the meter and 3 + 4 outside disconnected

Specific resistance of $ZnSO_4$ pure water solution

2 plates of pure zinc alloyed with 5% Mercury by weight were ground and polished on one face. The other sides and the rims were varnished. The Dimension were

Length 3·95" = 10·00 cms.
Breadth 2·02" = 5·18 cms.
Area 51·8 sq. cms.

These plates were separated by four little blocks of wood cut from a match, at the corners.
With separation 0·135" = 3·43 × 10⁻¹ cms. Temp. Bd. 21·7°C
Bridge 100 ~/~ 50 mms.

Test	Bridge ~/~	Mer.	Obtained Res. TZ	Obtained Res. FZ	Corrected for lead T.Z.	Corrected for lead F.Z.	Mean TZ	Mean FZ	Sp. Res.
I	100/10	2·5	0·80	0·47	0·79	0·46			
	separation	10	0·47	0·45	0·46	0·44	0·60	0·50	7.55×10^{10}
	0·3143 cm	40	0·545	0·535	0·53	0·53			
		160	0·605	0·570	0·60	0·56			
II	separation	2·5	1·02	1·00	1·01	0·99			
	0·24"	10	1·00	0·92	0·99	0·91	0·87	0·83	7.05×10^{10}
	0·61 cm	40	0·81	0·75	0·80	0·74			
		160	0·69	0·68	0·68	0·67			
III	separation	2·5	1·45	1·45	1·44	1·44			
	0·46"	10	1·49	1·47	1·48	1·46	1·38	1·34	5.86×10^{10}
	1·17 cm	40	1·45	1·45	1·44	1·44			
		160	1·15	1·05	1·14	1·03			

The areas and dimension of different metre plates are as follow.

No. of Plate	Length		Breadth		Thickness		Area of any face of side		Area of 3 sides of trim		Total area	
	In.	Cms	In.	Cms	In	Cms	Sq. in.	Sq. cms	Sq. in	Sq. cms	Sq. in.	Sq. cms
6	0.80	2.05 ~~1.75~~	0.75	1.875	0.25	0.603	0.5625 1.1250	3.6~~6~~ 7.680	0.568	3.632	1.688	11.3~~7~~10
12		4.7		1.9		0.6		8.93 17.86		6.78		24.64
25		7.7		2.5		0.6		19.25 38.50		10.74		49.24

Inside Reductions

No	Reduction for length that breadth				Area of		Depth of collar		Areas cut by collar		Total area exposed for wear in 1 plate on one side	
	In	Cms	In	Cms	Sq. in	Sq. cms	In.	Cms	Sq. in	Sq. cms	Sq. in	Sq. cms
6	0.80	2.05	0.25	0.65	0.20	1.33	–	–	–	–	0.40	2.66
12		1.0		0.65		0.65		0.7		0.34		2.07
25		1.1		1.4		1.54		1.3		1.33		5.74

Table of External Reductions.

Plate	Nut Diam		Area of do		Total nut area		Screw head Diam		Area of do		Total Screw head area	
	In.	Cm.	Sq. in	Sq. cm	Sq. in	Sq. cm	In	Cm.	Sq. in	Sq. cm	Sq. in	Sq. cm
6		0·80		0·50		0·50		0·55		0·24		0·24
12		0·80		0·50		1·00		0·55		0·24		0·48
25		1·35		1·43		2·86		0·85		0·56		1·12

Total Reductions for existing plates.

Plate	Total inside		Total nut		Total Screwhead		Sum.		Remaining effective area on the back plate		Remaining effective area on one side plate	
	Sq. in	Sq. cm	Sq. in	Sq. cm	Sq. in	Sq. cm	Sq. in	Sq. cm	Sq. in	Sq. cm	Sq. in	Sq. cm
6		2·66		0·50		0·24		3·40		14·44 ~~[illegible]~~		9·72 ~~[illegible]~~
12		2·07		1·00		0·48		3·55		45·73 ~~[illegible]~~		22·87 ~~[illegible]~~
25		5·74		2·86		1·12		9·72		88·74		44·38 ~~[illegible]~~

Total Effective Area, if tracks cured

Plate	At present Total		Consolidated reduction		Remaining effective area		Effective area if one side plate Back area		Back area Remaining effective area		Remaining effective area on each	
	Sq. in	Sq. cm	Sq. in	Sq. cm								
6		~~19·66~~ 22·74		2·66		20·08		7·68		12·40		6·20
12		26·64 ~~48·27~~		2·07		~~46·24~~		17·86		29·35		14·67
25		~~[illegible]~~ 98·68		5·74		92·74		28·50		54·24		27·12

Calculation for Mean Current

Hook		Torsion		
30' @ 118 =	3540	40' @	33.57 =	134.28
75 @ 163 =	12223	75 @	34.27	257.00
45 @ 210 =	9.450	45 @	34.74	156.33
70 @ 225	15750	70 @	34.92	244.48
220	40960	230		792.09
11	20450			
	186			

Calculation for Current strength.

(a) by $\log_e$

Time = 229 mins = 13740 secs = 1.3740×10^4

Wt of log plate before 5.460

" " " after 5.339

loss 0.121 grms

$2 \times 0.00001039 \times 1.3740 \times 10^4 = 0.121$

$\times = 1.21 \times 10^{-4}$

$\times = (1.21 / 1.11815 \times 1.3740) \times 10^{-3} = 7.874 \times 10^{-3}$ ampere

(b) by Zn

Weight of plate before 44.3344

" " after 44.2955

loss .039

$2 \times 0.00001039 \times 32.44 \times 1.3740 \times 10^4 = 0.039$

$2 \times 1.038 \times 32.44 \times 1.3740 = 3.9 \times 10^{-3}$

$2 \times 1.038 \times 2.2444 \times 1.3740 = 3.9 \times 10^{-3}$

$2 \times (3.9 / 4.622) \times 10^{-3} = 8.43 \times 10^{-3}$ amps

3.186	3.376	7.78	44.94
7.874	7.874	7.87	7.874

Thursday 13th September

44

Measurement of Constants of Instruments

Fine wire coils

Connected up the (1) Hook fine wire

(2) Bunbitt

(3) Siemens

(4) Torsion Dyne.

with an Edison 1st meter cell and a Silver Voltameter. Battery 20 Ballands.

Weight of Silver plates: 8.0 o'clock (1) 5.4604 grms

(2) 5.5304

(1+2) 10.9924

~~Zinc plates~~: arithmetical sum 10.9908

Weight of Zinc plates 8.0 o'clock (1) 44.3344

(2) 44.1599

zero on dyne before current 9.8 } 10.00.
" " after 10.2 }

with sum 88.4939

Current on 11.29.00 off 15.29.00

sum 192 88.4933

No. of obs.	Time	Hook Fine Def	Hook Corrected Average	Siemens Def.		Bunbitt Scale Rg		Torsion Dyne Torsion Rg	
1	11.30.00	3.10		73°.30'		7.3		33.24+	
2	11.30.00	3.115		73°.30'		7.5			
3	Noon	3.120	3.186	73°.30'	73°.30'	7.5	7.75	33.9+	34.24
4	13.15	3.228	"	73°.30'		7.75		34.64+	zero 10.0
5	14.00	3.22		73°.30'		7.80		34.83+	
6	15.00	3.23		73°.30'		7.80		35.04+	

Weight of Silver plates 16 o'clock (1) 5.3288 Eq 61216

(2) 5.4174 " 61170

sum 10.7462

1+2 obs 10.9860

Weight of Zinc plates 16 o'clock. (1) 44.2952 Eq 64389

(2) 44.1904 " 64306

sum 88.4856

1+2 obs 88.4850

Constant of Instruments

Hook Fine wire	Siemens Fine wire	Bunbitt	Torsion Dyne
0.00045 per unit	0.00286 23°.12' per unit	Under indicating 1.5%	0.627 1.5% x 1.874, zero

Meter Measurements Continued.

Coil No.	Time	Res. in cet.	Mo	Observed T.Z.	Observed F.Z.	Lead	T.Z.	F.Z.	T.C.
I	8.30	700 ω	10	2.85	2.75	0.95	1.90	1.80	19.4°C
II	14.9.98	1000/10		2.74	2.70		1.79	1.75	
III				3.64	3.60		2.69	2.65	
IV		T.B. 18.1°C.		4.35	4.15		3.40	3.20	

after 24 hours

I	8.25	700 ω	Mo	2.87	2.80	0.95	1.92	1.85	16.5°C
II	15.9.98	1000/10		2.78	2.70		1.83	1.75	19°C
III		10 Mo	10	3.83	3.60		2.88	2.65	
IV		T.B. 18.5°C		4.66	4.35		2.71	3.40	

after 48 hours

I	8.20	700 ω	10	2.52	2.30	0.61	1.91	1.69	20°C
II	17.9.98	1000/10		2.44	2.30		1.83	1.69	
III		10 MΩ		3.44	3.25		2.83	2.64	
IV		T.B. 19.5°C		4.25	4.00		3.64	3.39	

Experiment then concluded.

Calculation for specific resistance.

Separation 0.09" = 0.229 cms.

@ 23.5°C. = 74° F F.Z. Res 0.9 ω.

$$\frac{51 \times 0.9 \times 10^3}{0.229} = \frac{45.9 \times 10^{10}}{2.29 \times 10^{-1}} = 2.03 \times 10^{10} \text{ or } 20.3 \times 10^{9}$$

Repeated the lower reading after removing cell from ice bath and allowing it to regain normal temperature.

No. Obs.	Time of Obs.	Res. in cell 22°.	Mag	T. cell °C	Observed T.Z.	Observed F.Z.	Leads	Leads Deducted T.Z.	Leads Deducted F.Z.
29	15.05	720	10	5.5	3.75	3.45	0.66	3.09	2.79
30	.13	"	"	6.6	2.62	2.20		1.96	1.54
31	.16	"	"	7.7	2.47	2.22		1.81	1.56
32	.20	"	"	8.8	2.41	2.25		1.75	1.59
33	.21	"	"	10.0	2.37	2.17		1.71	1.51
34	.25	"	"	11.1	2.31	2.20		1.65	1.54
35	.28	"	"	13.3	2.22	2.10		1.56	1.44
36	.30	"	"	14.4	2.13	2.11		1.47	1.45
37	.31	"	"	15.5	2.09			1.43	
38	.32	"	"	16.6	2.00	1.90		1.34	1.24
39	.32	"	"	17.7	1.98			1.32	
40	.32	"	"	18.3		1.75			1.09
41	.34	"	"	20.0	1.90	1.76		1.26	1.10
42	.37	"	"	21.1	1.82	1.70		1.16	1.04
43	.40	"	"	22.2	1.75	1.65		1.09	0.99

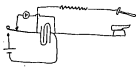
Specific Resistance tests. contd:

The same two plates exposing 51 sq. cms. of surface were again employed after cleaning. The solution was the same pure solution the sp. gr. being 1.063 @ 22°C. The all was heated in a sand bath and observations taken as it cooled. It was then put into an ice water bath & cooled further.

No. Obs.	Time of Obs.	Res. in cell 22°.	Mag	T. cell °C	Observed Res. T.Z.	Observed Res. F.Z.	Leads	Leads Deducted Res. T.Z.	Leads Deducted Res. F.Z.	Spec. Res.
1	11.14	2.900	2.5	44.4	0.99	0.94	0.65	0.34	0.29	Separation 0.229 cm.
		720	10	do	1.00	0.95		0.35	0.30	
		157	40	do	0.95	0.93		0.30	0.28	
2	.28	720	10	37.7	1.12	1.03		0.47	0.38	
3	.29	"	"	35.6	1.14	—		0.49	—	
4	.30	"	"	34.4	—	1.10			0.45	
5	.31	"	"	33.8	1.17	1.12		0.52	0.47	
6	.34	"	"	33.8	1.20	1.16		0.55	0.51	
7	.37	"	"	33.3	1.28	1.23		0.63	0.58	
8	.38	"	"	31.1	1.30	1.25		0.65	0.60	
9	.40	"	"	30.0	1.32	1.27		0.67	0.62	
10	.42	"	"	28.8	1.34	1.29		0.69	0.64	
11	.44	"	"	27.7	1.35	1.30		0.70	0.65	
12	.47	"	"	26.6	1.39	1.34		0.74	0.69	
13	.51	"	"	25.5	1.45	1.40		0.80	0.75	
14	.55	"	"	24.4	1.55	1.49		0.90	0.84	
15	.59	"	"	23.3	1.61	1.55		0.96	0.90	2.03×10^{10}
16	13.50	"	"	20.5	1.60	1.55		0.95	0.90	
17	.56	"	"	17.7	1.79	1.73		1.13	1.08	
18	14.03	"	"	15.5	2.06	1.93		1.41	1.28	
19	.05	"	"	14.4	2.10	2.00		1.45	1.35	
20	.10	"	"	12.2	2.16	2.05		1.51	1.40	
21	.13	"	"	11.6	2.35	2.25		1.70	1.60	
22	.18	"	"	11.1	2.52	2.40		1.87	1.75	
23	.23	"	"	10.0	2.73	2.50		2.08	1.87	
24	.26	"	"	8.9	2.85	2.63		2.20	1.98	
25	.30	"	"	7.2	3.10	2.90		2.45	2.15	
26	.35	"	"	6.6	3.26	2.95		2.61	2.30	
27	.50	"	"	5.5	3.41	3.15		2.76	2.50	
28	15.03	"	"	5.0	3.85	3.35		3.20	2.70	

Repeated same test with a solution of nearly saturated solution of $Zn\,SO_4$ Density 1.41 @ 18.4°. Same plates. Same conditions.

No.	Time	Rec in sec.	Mag.	T. gal.	Observed T.I.	Observed F.I.	Leads	Leads – Deduction T.I.	Leads – Deduction F.I.
1	16·38	720 sec.	10	14·4	1·23	1·11	0·66	0·57	0·45
2	·39	700 sec.		13·8	1·25			0·59	
3	·40			13·3	1·28	1·18		0·62	0·52
4	·42			12·2	1·33	1·20		0·67	0·54
5	·46			11·1	1·40	1·28		0·74	0·62
6	·49			10·0	1·44	1·30		0·78	0·64
7	·51			9·8	1·48			0·82	
8	·56			8·3	1·50	1·35		0·84	0·69
9	·58			8·8	1·49	1·34		0·83	0·68
10	17·01			10·0	1·42	1·30		0·76	0·64
11	·03			11·1	1·33	1·23		0·67	0·57
12	·04			12·2	1·32	1·22		0·66	0·56
13	·05			13·3	1·26	1·16		0·60	0·50
14	·07			14·4	1·23	1·11		0·57	0·45
15	·08			15·5	1·19	1·06		0·53	0·40
16	·09			16·6	1·15	1·03		0·49	0·37
17	·09½			17·7	1·12	1·01		0·46	0·35
18	·10			18·8	1·08	0·98		0·42	0·32
19	·11			20·0	1·055	0·96		0·40	0·30
20	·12			21·1	1·03	0·92		0·37	0·26
21	·12½			22·2	1·01	0·90		0·35	0·24
22	·13			23·3	0·99	0·89		0·33	0·23
23	·18			25·0	0·965			0·31	
24	·19			25·5	0·94	0·84		0·28	0·18
25	·20			26·6	0·93	0·83		0·27	0·17
26	·21			27·7	0·905	0·82		0·25	0·16
27	·22			28·8	0·89	0·81		0·23	0·15
28	·23			30·0	0·88	0·80		0·22	0·14
29	·24			31·1	0·86	0·79		0·20	0·13
30	·25			32·2	0·85	0·79		0·19	0·13
31	·26			33·3	0·84	0·79		0·18	0·13
32	·27			34·4	0·82	0·78		0·16	0·12
33	·28			35·5	0·815	0·77		0·16	0·11
34	·29			36·6	0·81	0·77		0·15	0·11
35	·30			37·7	0·80	0·77		0·14	0·11



Dick Key Insulating Between back of front contact

Calculation of time.

General formula. $t = 2.303\, R\, \log \frac{C}{E}$

$0.02572 \times 2.303 \times 0.001 = 2.572 \times 2.303 \times 10^{-5}$	0.000059 sec.
$0.122514 \times 2.303 \times 0.0005 = 6127 \times 2.303 \times 10^{-5}$	0.000141 .
$0.09061 \times 2.303 \times 0.0003 = 2715 \times 2.303 \times 10^{-5}$	0.000062 .
$0.26314 \times 2.303 \times 0.00010 = 2.631 \times 2.303 \times 10^{-5}$	0.000061 .
$0.58995 \times 2.303 \times 0.00010 = 5.9 \times 2.303 \times 10^{-5}$	0.000136 .
$0.33324 \times 2.303 \times 0.00010 = 3.332 \times 2.303 \times 10^{-5}$	0.000767 .

Anvil Experiments.

Took a small anvil weighing 22.5 kilos and laid it on the outer Galv room floor. On some sheet gutter pieces heavy. Time 15.30 1/9 a cell (Black) was arranged to charge the Stt 1st and by striking the anvil with a hammer so as to let it rebound the condenser could discharge through the contact and an adjustable resistance.

The hammer used weighed 128 grammes.

The Battery Galv. was employed.

No	Conditions of Floor	Full Dwell	Rest in cell	Stat Dwell after Floor	Mean	$\frac{C}{E}$	t
1	Flat end of hammer on anvil	246					
2			10000	229			
3			"	232			
4			-	230	230	$\frac{246}{230} = 1.061$	5.92×10^{-5}
5			500	184	184	$\frac{246}{184} = 1.326$	11.11×10^{-5} ?
6			300	198	198	$\frac{246}{198} = 1.232$	8.26×10^{-5}
7			100	116			
8			-	114			
9			-	119.5			
10			-	168			
11			-	124		$\frac{246}{133} = 1.834$	6.07×10^{-5}
12			-	152			
13			-	132			
14			-	122			
15			-	126			
16				133	133		
17	Sharp end Hammer		100	63	63	$\frac{246}{63} = 3.89$	13.6×10^{-5}
18	Edge of hammer flat on anvil		-	108			
19			-	131	112	$\frac{246}{112} = 2.189$	7.67×10^{-5}
20	Sharp end Hammer		-	103			
21		246					

$0.3156 \times 2.303 \times 10^{-4}$

$0.14426 \times 2.303 \times 2 \times 10^{-4} =$

Anvil Experiments contd 14th September

Used the same anvil and hammer as in yesterday's experiments.

No.	Condition of blow	Full Dia.	Res. in ect.	Obsd. Diech after blows	Means	$\frac{C}{c}$	t
1	Blunt end on anvil	244	100ω	100			
2				108			
3				123			
4				114			
5				125			
6				112			
7				70			
8				112		$\frac{244}{118} = 2.068$	7.27×10^{-5}
9				123			
10				130			
11				131			
12				130			
13				130			
14				115			
15				120			
16				131			
17				112			
18				137			
19				118	118		
20			200ω	158			
21			200ω	204			
22			200ω	170			
23			200ω	201			
24			200ω	130		$\frac{244}{175} = 1.394$	6.65×10^{-5}
25			200ω	173			
26			200ω	172			
28			200ω	183			
29			200ω	181	175		

$0.42224 \times 2.303 \times 10^{-5} =$
$0.3119 \times 2.303 \times 10^{-6} =$
$0.4041 \times 2.303 \times 10^{-3} =$
$0.0792 \times 2.303 \times 10^{-6} =$
$0.1999 \times 2.303 \times 10^{-2} =$

Anvil experiments continued.

Joined up the 113 volt terminals directly to the hammer and anvil through 0.6m of double cord and a leaden safety catch at the dynamo terminal (6mm long) and 0.06 mm diam. On striking the anvil with the hammer there was always a spark and a ~~bas~~ slight erosion of the mutual surfaces but out of six or seven trials the safety catch only broke once and that was in the case of an unfair blow.— Next tried a heavier hammer.

No.	Conditions	Full Disch	Res: insert	Disch after blow	Mean	$\frac{C}{E}$	t.
1	Same anvil & sheet as of hammer weighing 115g	24.6	100m	93			
2				84			
3				102			
4				83			
5				93		$\frac{24.6}{93} = 2.645$	9.73×10^{-6}
6				97			
7				95			
8				107			
9				102			
10				75			
11				90	93		
12	Sheet lead 0.5 thick on anvil		100	~~[illegible]~~ 12	12	$\frac{24.6}{12} = 205$	3.02×10^{-6}
13			1000m	84			
14	all three heavily dented			50	97	$\frac{24.6}{97} = 2.536$	9.3×10^{-6}
15				84			
16				180			
17	Sheet brass on anvil		1000m	205	205	$\frac{24.6}{205} = 1.20$	1.52×10^{-6}
18			100m	17			
19				50			
20				56			
21				25		$\frac{24.6}{31} = 7.932$	~~[illegible]~~ 3.97×10^{-6}
22				27			
23				12	31		
24			300	116			
25				98			
26				97			

$0.42504 \times 6.909 \times 10^{-4} = 2.94 \times 10^{-4}$
$0.25912 \times 6.909 \times 10^{-4} = 1.79 \times 10^{-4}$
$0.17435 \times 6.909 \times 10^{-4} =$

No.	Condition	Weight Dist	Brightness	Full to Dim	Mean	$\frac{c}{c}$	t.
27		300w	117				
28			116				
29			54		92.9	$\frac{247}{92.9} = 2.661$	2.94×10^{-4}
30			53				
31			75				
32			138				
33			62				
34	dropping sharp on annul	300w	75				
35			81				
36	sharp end		157				
37	" "		140				
38	flat "		182				
39	" "		111				
40	" "		100	126	136	$\frac{247}{136} = 1.816$	1.79×10^{-4}
41	" "		180				
42	" "		105				
43	" "		182				
44	" "		157				
45	" "		165				
46	cut min dark on one	300w	182				
47			175				
48			179				
49			188				
50			185				
51			178				
52			179				
53			69 ?				
54			125		168.3	$\frac{247}{168.3} = 1.494$	1.21×10^{-4}
55			110				
56			186				
57			162				
58			150				
59			172				
60			167				
				247			
				248.			

This diagram shews the connections. The cake has 8 fine platinum wire sealed into it, & the wires coming from these little plates are all covered in rubber tubing.

Alternating Current Electrolysis

Graduated a bell terminating off glass tube from a burette as follows—

Reading No.	1st Burette Reading	2nd Burette Reading	Difference c.c.	1st glass tube reading	2nd Glass tube reading	c.c. per cm of tube	Mean	Residual
1	18·40	26·60	8·20	zero scratch	29·9	0·2743		0·0059
2	30·30	32·70	2·40	do.	9·05	0·2672		0·0011
3	32·70	34·55	1·85	9·05	15·80	0·2740		0·0056
4	34·55	36·50	1·95	15·80	23·35	0·2582		0·0102
5	36·50	38·70	2·20	23·35	31·50	0·2698		0·0014
	30·30	38·70	8·40	zero scratch	31·50	0·2666	0·26844	

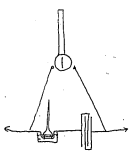
No of Reading	Residual	Sqs of Res	Sum of Sq	$\sqrt{\frac{\Sigma}{N(N-1)}}$		$0.6745\sqrt{\frac{\Sigma}{N(N-1)}}$	Probable error	Result
1	5.9×10^{-3}	34.81×10^{-6}						
2	1.1×10^{-3}	1·21	173.98×10^{-6}	$\sqrt{\frac{173.98\times10^{-6}}{20}}$	2.95×10^{-3}	1.99×10^{-3}	± 0.00199	0·26844 cc
3	5.6×10^{-3}	31·36					± 0.002	
4	10.2×10^{-3}	104·04	1734×10^{-6}	$\sqrt{\frac{1734\times10^{-6}}{5}}$				
5	1.4×10^{-3}	1·96						

A solution of 10% CP H_2SO_4 in esp. dest. was employed its density being 1·065 @ 19° C.

A glass evaporating dish 11·5 cms diam + 6·3 high (inside) = 103·9 cc cms filled to about 2 cms high = 215·6 cc. The glass tube was 37·5 cms long, about 0·6 cm int diam 0·8 ext communicating with a bell resting on a base 7 cms diam 6·3 cms high but 10 cms high to the inner base of tube. The total height 47 cms. The scratch was 2·1 cm from the top. The working cake was 5 cms in diam its upper surface 1·2 high as it rest.

Voltage Table.

No.	Gardner Reading	Corresponding Gardner Voltage	Mean alternating Voltage	No.	Gardner Rdg.	Corresponding Gardner Voltage	Mean alternating Voltage
1	80°	102.0	91.9	7	86°	106.7	96.0
2	81°	102.7	92.4	8	87°	107.5	96.8
3	82°	103.5	93.1	9	88°	108.3	97.5
4	83°	104.3	93.9	10	89°	109.1	98.2
5	84°	105.1	94.6	11	90°	109.9	98.9
6	85°	105.9	95.3				



The following table shews the length and area of the little wire plates used.

Plate No.	Diam.	Length	Cylinder Surface	Section Surface	Sum	Reciprocal	Sum from small end	Starting at 1st det.	Quantity at 1st det.
1+7	0.097"	1.5	8.39×10^{-4}	8.41×10^{-4}	8.415×10^{-4}	5.93×10^{3}	21.585		
2+8	0.0175"	1.0	5.59×10^{-4}		5.62		13.140	1 cm.	3.7 coul.
3+9	do	0.8	4.47×10^{-4}		4.50		7.520		
4+10	do	0.4	2.24		2.27		3.020		
5+11	do	0.1	0.56		0.585		0.750		
6+12	do	0.025	0.14		0.165		0.165		
Total							$\times 10^{-4}$		

The alternating Sumin Dynamo was fed by the 113 volt cct. The wires from it came to the Terminal Board thence to terminals 80, 81 thence to the south side across the room by dark cord. at the experimental table the connections were as shewn.

Marshalls Gardiner voltmeter used at first and subsequently the Elliott also.

The volts were read by the Gardner and subsequently by the Quadrant Electrometer as well.

The Machine made ~~1470~~ 1470 revs. very steadily during the experiment which was made between 17 and 18 also between 20.30 and 23.30 on the 10th Sept^br.

$= \frac{8 \times 1470}{60} = 196$ Alternations per sec.

The general formula is

$V = 5.143 \times E_{max} \times n \times k \times t \times 10^{-7}$

here $n = 196$ and $k = 4$ $\quad nk = 784 \times 10^{2}$

$V = 4.258 \times E_{max} t \times 10^{-5}$

The equivalent current $= 2n \times \frac{\pi}{2} \times E_{max} \times kt = n\pi E_{max} kt \times 10^{-7}$

$= 615.75\, E_{max} kt \times 10^{-7}$

$6.158 \times 4 = 24.632\, E_{max} \times 10^{-4}$ $\quad$ where $n = 196$. $= 6.158\, E_{max} kt \times 10^{-5}$

Calculations

No.	Equivalent Capacity on Capacity	Geometrically Calculated	Calculated Inductance	Current per cm. of plate for 1 Ampere	Power of plate per unit c.	Ratio $\frac{\text{Calc}}{\text{Obs}}$	Remarks
1.	0.0240	1.383	{20.57 / 22.54}	$\frac{1.18 \times 10^{-3}}{8.94}$	8.9444	{0.0463 / 0.053} / {0.4076 / 0.390}	Gas diminishing [illegible]
2	0.0239	5.02	{12.37 / 13.28}	7.96×10^{-3}	1.263		
3	0.0236	8.20	{9.78 / 10.46}	3.15	0.318	{0.8388 / 0.7944}	Temp 19°
4	0.0115	2.50	{2.38 / 2.55}	6.97	0.1143	{1.050 / 0.980}	
5	0.0234	7.44	{7.27 / 7.78}	14.18	0.070	{1.023 / 0.956}	
7	0.0235	7.45	{7.31 / 7.82}	average 6.26	0.160	{1.019 / 0.953}	66 Cycles = 10.89 E. q. E only 0.35
8	0.0114	3.13	{3.54 / 3.78}	average 3.04	0.329	{0.8846 / 0.826}	q. E very 0.1
9	0.0173	5.11	{5.38 / 5.72}	average 4.61	0.217	{0.9558 / 0.893}	q. E only 0.2
11	0.0293	6.57	{6.09 / 6.51}	5.01	0.200	{1.079 / 1.009}	q. E only 0.55
12	0.0294	6.57	{6.09 / 6.51}	5.01	0.200	{1.079 / 1.009}	q. E only 0.5
13	$\frac{0.01}{1.75} = 0.0102$	7.04	{12.65 / 13.53}	2.09	0.478	{0.557 / 0.526}	q. E = for the 42.8 [illegible] 0.1
14	$\frac{0.0}{3.6} = 0.0137$	8.26	{8.09 / 8.66}	5.93	0.169	{0.921 / 0.888}	q. E = for [illegible] 25 q. E = for 0.6
15	$\frac{0.0}{3.6} = 0.0137$	8.22	{8.09 / 8.66}	5.93	0.169	{1.016 / 9.95}	〃 〃

Observations

No.	Times	Capacity	Wire in set	Areas	Condenser Pots	Mean Voltage	Seconds clapping	Length of [illegible]
1	17. 13.00 / 21.00	4	1 4 12	21.56×10^{-3}	87°.45'	97.3	500	5.15
2	17. 31.00 / 36.00	4	$\frac{4}{2} \times \frac{8}{12}$	3.02×10^{-3}	87°	96.8	300	18.7
3	17. 40.00 / 46.00	4	$\frac{8}{2} \times \frac{12}{12}$	7.5×10^{-3}	88°.30'	95.7	240	30.55
4	17. 53.00 / 55.00	2	6 4 12	1.65×10^{-3}	82°	93.1	120	9.3
5	17. 57.00 / 18.00.00	4	6 + 12	1.65×10^{-3}	84°.20'	94.8	180	27.7
6	21. 20.00	4	6 + 12	1.65×10^{-3}	83°	93.9	No 6 burnt.	
7	21. 29.00 / 35.00	4	5 + 12	$\{5.55 \times 10^{-3} / 1.65 \times 10^{-3}\}$	85°.15'	95.4	180	27.75
8	21. 39.00 / 42.00	2	5 + 12	$\{5.55 \times 10^{-3} / 1.65 \times 10^{-3}\}$	81°	92.4	180	11.65
9	21. 46.00 / 49.00	3	5 + 12	$\{5.55 \times 10^{-3} / 1.65 \times 10^{-3}\}$	82°	93.1	180	19.05
10	21. 57.00	5	5 + 12	$\{5.55 \times 10^{-3} / 1.65 \times 10^{-3}\}$	80°	91.9	No 12 burned [illegible]	
11	22. 04.00 / 09.00	5	5 + 11	5.55×10^{-3}	85°	95.3	120	24.5
12	22. 06.00 / 08.00	5	5 + 11	5.55×10^{-3}	85°.15'	95.4	120	24.5
13	22. 17.00 / 27.00	7 [illegible]	5 + 11	5.55×10^{-3}	80°.20'	92.1	600	26.25
14	22. 44.30 / 49.45	2 [illegible]	5 + 11	5.55×10^{-3}	78°.00	90.4	135	30.80
15	22. 52.45 / 57.00	1 [illegible]	5 + 11	5.55×10^{-3}	78°.00	90.4	135	30.65

Measurements with resistance only in the circuit.

#13) On 708 ω increased by temp to say 720 ω the q. Electrometer reading was 42.8.

that on the voltameter was 0.1

$\sqrt{42.8} = 6.54 : \sqrt{0.1} = 0.316 :: 720 : x$

$x = 34.8$ the voltameter res.

#14) On one lamp a 96 volt 10 cp lamp the q. E reading was 35.25

while on the voltameter 0.6

$\sqrt{35.25} = 5.94 : \sqrt{0.6} = 0.775 :: x : 32.5$ $x = 224$

$: 30$ $x = 230$

#15) On the lamp 34.5 $\sqrt{34.5} = 5.87$
" " bolts 0.55 0.742 } 6.61
" both 45.05 $\sqrt{45.05} = 6.71$

$5.87 : 0.80 :: x : 30$ $x = 220$

#16 On the lamp 34.6 $\sqrt{\ } = 5.88$ } 6.55
bolts 0.45 $= 0.67$
" both 44.7 $\sqrt{\ } = 6.69$
Barlow. 77½°

#17 Prepaid potential of night cct. with Barlow and q. E lect.
106.5 volts by Potentiometer
106.5 " Dow voltmeter
85°.125' on Barlow 2
56.70 on q. E $\sqrt{\ } = 7.53$

Calculations for the starting resistance to be inserted between a #8 Dynamo and a #6 used as a motor.

The E.M.F. of the no 8 is about 125 volts. The res of a #6 armature is 0.033 ω the initial starting current ought not to exceed 20 amperes so that 6 ohm might be made the full amount, the coils might be made

⅛	¼ω	½ω	1ω	3ω	6ω
70'	60'	50'	40'	30'	20'

The carrying capacity of the separate resistances will be.

⅛	¼	½	2	3

If these be made all of the same length but the diameter be varied the res: of 1280 feet of wire $= \frac{364\,000}{d^2}$ @ 60°

1 foot $= \frac{364\,000}{5\,000} = \frac{72}{d^2}$

$\therefore \frac{72}{d^2} = 3$ or $d^2 = 24$, $d = .005$ per foot.

Say that 10 feet will be the length of wire

then $\frac{720}{d^2} = 3$ or $d = \sqrt{240} = 15.5 = 0.016'$ #27

$\frac{720}{d^2} = 2$ or $d = \sqrt{360}$ $19.1 = 0.019'$ #25

$\frac{720}{d^2} = 0.5$ or $d = \sqrt{1440}$ $37.9 = 0.038$ # 20

$\frac{720}{d^2} = 0.25$ or $d = \sqrt{2880}$ $53.6 = 0.054$ # 17

$\frac{720}{d^2} = 0.125$ or $d = \sqrt{5760}$ $75.9 = 0.076$ # 15

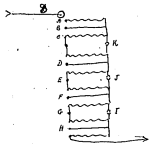
If they are all on

Mater experiments continued.

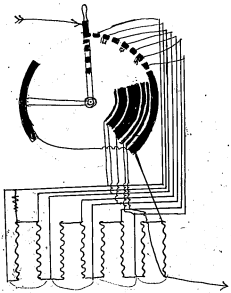
Continued from page 40

Corns	Date	Time	Resistance	Mass Tot	Bipower T.Z.	Bipower F.Z	Lude	Dolomite T.Z.	Dolomite F.Z.
12	14/9	17.40	700	10 247	70000	50000	0.53	69.5	49.5
12	15/9	8.55		22.8	69.00	49.00	0.18	66.8	48.8
			amalgamated plate						
12		11.30			35.00	32.00	0.18	34.82	31.72
12	17/9	11.35	690	22c	42.00	35.5	.18	41.82	35.32
				25 lifter corns					
25	14/9	17.00	700	10.2172	74000	50000	0.53	73.5	49.5
25	15/9	8.55			60.00	48.00	.18	59.8	44.8
			amalgamated plate						
25		13.05			16.20	15.70	.18	16.02	15.52
25	17/9	11.35	690	22c	29.10	27.30	.18	28.92	27.12

Design for a resistance coil



The rolling contact S slides from A to H. After it stops at H connections are closed at I J and K and a strip covers in succession all the contacts from H to A



Meter tests Continued:
Following are results of a set with different zeros
6 Light Meter in series. Current about 2 amperes

No. of Test	Empty	Rod	Weight 9th Sept.	Joint the Weight	Weight 17th Sept.	Joint the Weight	Loss.	Gain
1	1/4 lg	A	24.4237	47.8195	23.3875	47.850	1.0362	0.0450
2	..	C	23.3395		24.4609		0.919	1.1244
Sum			47.8232		47.8514			
3	..	E	24.6593	49.4281	24.7287	49.410		0.059
4	..	B	24.7706		24.680		0.0906	
Sum			49.4299		49.4087			
5	-	A	25.0633	49.3537	24.2325	49.305	0.8308	0.0512
6	-	E	24.2921		25.0755		0.2166	1.7754
Sum			49.3554		49.3080			
7	Plus		24.4645	50.1592	24.4169	50.1346	0.1576	1.2246
8	"		25.6947		25.7190		1.1791	0.0133
Sum			50.1612		50.1359			
11	-		24.3700		24.3226	49.1600	0.0474	0.4630
12	-		24.8637	49.3322	24.8385		0.5413	0.0215
Sum			49.2337		49.1609			
9	"		24.2814		24.2448	49.1624		0.5821
10	-		24.8982	49.1788	24.9176			
Sum			49.1796		49.1622			
13	"		25.5100	50.3734	25.4302	50.3588	0.0798	0.0550
14	5/4 lg		24.8634		24.9286			
Sum	-		50.3734		50.3588			
15	-		24.7076	49.1269	24.6226	50.1273	0.0850	
16	-		24.4201		24.5045			0.6454
Sum			49.1277		49.1271			
17	-		23.1736	47.9455	25.7403	50.4014		2.5667
18	-		24.7737		25.6604			0.6257
Sum			47.9473		50.4007			
19	1/4		23.1736	47.9455	24.7796	47.9377		0.0043
20			24.7737		23.1606		0.1130	
Sum			47.9473		47.9392		0.0001	
21	5/4		26.2166	52.4647	24.2448	52.4581		0.6266
22			26.2525		26.2115		0.0133	
Sum			52.4691		52.4563		0.0127	
23	plus	-	23.1773	47.0971	23.9274	47.1148		
24			23.9225		23.1874		0.0133	

Set up two 12 light meter side by side but kept an Edison lamp burning in the socket of one of them. Supplied them with about 4 ampères commencing at 10 o'clock 17. 9. 88. One temp. was 24·5° C and the other 42·2° C. (also about 23° C)

Gasoline experiment

Took an evaporating dish and supported on a bake plate about 3 cms high a small inverted glass vessel containing an ant. On pouring in 2 c.c. of cons. ether. The ant apparently died in about 6 mins. It revived however some time afterwards. Took the glass jar of the large storage battery and after blocking up a partition filled up the smaller compartment with Moulding sand. The dimensions of this compartment were 7 broad 21.5 long & 30 deep. At the depths of 7, 16, 19, 24, 26 and 30 cms from the surface little prisms made of thimbles were made with their open end against the glass. About 9 c.c. of gasoline were poured on to the surface of the sand this corresponding to a layer on the surface 0·06 cms high. The 7 cm ant died apparently at the end of 15 mins. The 16 cm. ant died after 19 mins. The 19 cm. ant after 40 mins and in 3 hours all were apparently dead except the lowest or 30 cm. ant which appeared stupified however. Next morning the first 7 cm. ant revived. The presence of the gasoline in these cells seemed to be confirmed by the condensation noticeable in them on the glass.

Poured some gasoline over oysters and clams both alive and closed, and also forcibly opened. No effect was noticed. An oyster solution was set apart at 10 o'clock 17. 9. 88 over the boiler to generate bacteria.

3rd Prepared a cylinder 4 cms diam × 38 high and filled it with moist but not wet sand. Poured 10 cc. of gasoline on the top. This corresponded to a layer (nearly) 1 cm in height. It visibly permeated downwards as far as 7 cms in dry and 5·5 cms in moist sand after one hour. Thereafter 6 & 7 respectively. Repeated the same with three.

4th Poured a small quantity (only four drops) on some earth worms.) Result fatal in about 5 min.

5th Took the jar mentioned above and filled it up to the height of 10 cms with sand. (ordinary red quite moist sand) The dimensions of the jar are internally 21·5 × 28·4 cm. (height 32 cms). Placed some worms at various depths in this sand, and some on the surface. Poured 150 c.c. of gasoline evenly over the top thus representing a layer 0·4 cms high over the whole area. The worms on the surface were dead in about 5 mins. Those at the bottom and ~~intermediate~~ depths were dead at the end of 90 min when the sand was examined. Most of the ~~intermediate~~ worms were found nearer the bottom than they had been placed.

6th. A clam that had been put into gasoline closed and alive, was found open and dead after some 20 hours immersion.

7th. Another clam was forcibly opened and the body suspended in gasoline. After about 6 hours, the bottom of the vessel contained about 2 c.c. of water drained from the clam.

8th. Took an old woolen coat. Tied up one sleeve to hold thermometer and then thoroughly drenched sleeve with gasoline. Temperature of air when thermometer first inserted in sleeve indicated at 82°F but the temp. of the air generally 76°F. After about 30 mins the temp. of the sleeve fell to 52°F.

9th. Repeated experiment but turned on small blast from foot bellows. No greater difference of temperature attained.

10th. Tried the other sleeve of the same coat with Rhigolene in place of gasoline. Temp. fell after about 15 mins to 23°F. (prior put on the sleeve)

11th. Repeated experiment but wringing sleeve out so that very little free rhigolene remained in it. ~~still~~ Temperature fell to 40°. only. Blast produced no visible effect.

12th. Poured a little rhigolene over a small wild pulpy leaved plant which it killed.

13th. Poured about 0.5 c.c. gasoline upon a small cricket which died nearly instantly.

14th Poured some gasoline (.0000 c.c.) 1 gall. on about one square metre of weeds in the courtyard equivalent to about 0.4 cm layer. ~~14th~~ on the 15th. All these weeds died.

15th Poured some Rhigolene on ~~two~~ small daisy weed. Plant drying in an hour. Next day plant not dead but very sickly.

16th Passed an alternating current at about 85 volts pressure through the large glass jar. The shock through the fingers felt on resting them at different points on the surface of the moist earth was distinctly appreciable. No effect however could be observed on ants or worms moving freely in the sand. The electrodes were zinc plate covering opposite sides of the jar.

17th Specific Gravity of Gasoline 0.69 @ 23°C.

18th " " Rhigolene 0.636 @ 23°C.

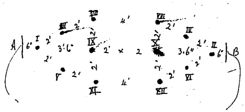
19th Poured about 1.5 pints of gasoline over roots of a bush. No destructive effect noticed.

20th Put 3 ants into a little copper vessel and corked up tightly. Then inserted same into mixture of ice and salt. The temp. fell to −5°C. The ant were exposed to this temp. for about 10 mins and were found to be dead on removal.

Magnifying power of microscope 290 diameters.

21st Put 3 ant into a small glass tube about 5 cms in diam. and 8 cms high closed with a rubber cork through a hole in which passed a thermometer. Some clean dry sand was put at the bottom to keep dry them. The whole was then inserted in melting ice.

These ants were apparently dead in 3 mins; temp. fair inside 20°C temp. " outside 24°C



Tuesday 18th September.

Buried two plates of zinc 34.5 × 28.3 cms. in the ground by the side of the Galvanometer room at a depth of and 12 feet apart with their planes parallel. The whole dynamo P.D. of about 113 volts was put on to the two plates AB in the figure. At the distances shewn holes were sunk in the ground and a stout iron bolt about 40 cms long sunk in each with a wire attached. The heads of the bolts stood at about ground level. The current passing through the plates and intervening ground was about 0.3 ampères at most, but the distribution must to a certain extent have been irregular through the resultant ground in the dynamo circuit being more on one side than on the other. The observed PDs were as follows

Combination	PD	Combination	PD.	Combination	PD.
1 2	·28	2 + 1	28	3 1	8.6
1 3	8.6	2 + 2	0	3 2	17.4
1 4	16.4	2 - 3	17.4	3 ~~4~~	8.3
1 5	7.7	2 - 4	7.6	3 5	0.1
1 6	16.0	2 - 5	18.1	3 - 6	7.45
1 7	12.7	2 - 6	7.2	3 7	2.75
1 8	13.2	2 - 7	16.0	3 8	4.8
1 9	10.0	2 - 8	10.8	3 . 9	
1 10	14.1	2 - 9		3 . 10	5.5
1 11	10.3	2 . 10		3 11	1.82
1 12	14.3	2 . 11 2 - 12		3 - 12	5.6

To find the depth of winding a wire on the bobbins of the Octofocal.

The formula p. 11. Book 3. is

$$l = \frac{\sqrt{D^2 + \frac{4Cd}{\pi t}} - D}{2d}$$

where l is the number of layers

D - - diam: of the empty core 7.2"

C - - length of the wire 15,300"

d - - covered diam of d. 0.0925

t - - number of turns in a layer 87

$$l = \frac{\sqrt{51.84 + \frac{4 \times 15,300 \times 0.0925}{87 \times 3.142}} - 7.2}{0.1854}$$

$$= \sqrt{51.84 + \frac{5631}{273.6}} - 7.2$$

$$= \sqrt{51.84 + 22.62}$$

$$= \sqrt{72.96}$$

$$= \frac{8.60 - 7.2}{0.1854} = \frac{1.40}{.1854} = 7.6$$

$= 0.74$" depth.

The outside diam is 1.20 + 7.2 = 8.4"

inside - - - 7.2"

15.7

mean - - - 7.85"

- - circumference = 24.67"

- - layer = 24.67 × 87 = 2099" = 175 ft.

7.6 layer = 1270 ft.

Gasolene experiments Contd.

In the last experiment on page 63 #21. The ants recovered after about an hour.

22nd Put on several more ant with the same chamber, the temp. being 22°C. Then dipped the base of the vessel into ice water and watched the effect. The immediate effect was a stimulus as though the ant felt the cold through the glass instantly. The subsequent effect was a gradually increasing lethargy, and they were all motionless after some 60 seconds from first immersion although the thermometer indicated no change. After 2 hours the temp. had only fallen to 13°C. The ants however had recovered and were no longer benumbed.

23rd Poured about 640 c.c. of gasolene over a marked area of about 144000 sq mm = 0.225 sq. meter to a depth of 0.025 cm and applied a match to the ground after 10 mins but there seemed to be no chance of inflammation. It was noticed however that many worms came up to the surface as though the gasolene had driven them up from below.

24th Spec. gravity of NH_4HO sol: 0.96 @ 22°C.
" " Burma Petroleum 0.802 @ 22°C.
" " $NaHO$ 20% sol. 1.071 @ 29°C.

25th Placed some ants in a battery jar 15 cms diam. + 21 deep filled with moist coarse red sand. Poured 25 c.c. of NH_4HO spec. g. as above on the surface (equivalent layer 0.14 cm) Gas seemed to penetrate the whole jar very quickly judging from the condensation on the interior surface. After 30 mins ant apparently unhurt

26th. Repeated experiment under precisely same condition, using however crude petroleum in place of ammonia.
After 30 mins no visible effect on ant in sand. The petroleum did not seem to penetrate to the bottom so readily.

27th/8 Poured about 6/10 c.c. of gasolene over some 10,000 sq. ins. of weedy soil in yard. After the lapse of 3 mins searched with a lighted match. Found the whole surface in very inflammable condition, catching fire instantly over the whole area. It was also noticeable that after the gasolene proper had apparently all been consumed, and the ground seemed only just moist at time of ignition, the weeds themselves burned fairly readily as though the gasolene had permeated their structures.

28th. Repeated experiment over another area of 10,000 sq. ins. and waited 8 mins before applying match. Succeeded in getting a small local inflammation at one spot, but none of the weeds there caught fire, and the ignition was only momentary.

Commutating Transformer

The completed transformer is constructed as follows

One outer gramme ring Diam (outer) composed of a core of wire diam 0.046 cm. The cross cross section being a circle 2.5 cm diam. On the core are wound 32 blocks of insulated wire 0.102 cm in diam or 0.138 cm covered. Each block has roughly 0.5 ω res: so that the tot res: is about 16 ω of the gramme ring.

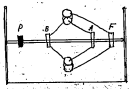
One inner gramme ring, composed of an iron wire core like the outer, but wound with two coils, in alternating blocks 32 in all. The diam: of the fine wire = " " " " coarse " "

The res: of each block of fine wire is about 13 ω and the actual resistance of the whole fine wire gramme ring is about 50 ω

The res: of each block of coarse wire is about 1 ω so that the actual resistance of the whole coarse wire gramme ring is about 4 ω.

These two circuits are brought to separate commutators, and the field or outer ring by

P. Pulley
F Field commutator
B Coarse wire or Secondary brush
A Fine wire or Primary.



The following results were obtained —
The best effect only are stated.

21. 9. 88

Time	Speed of Rotation Revs: per min	Set of Field Breaker ∠ with A	Set of Secondary Inductor ∠ with A	Dynamo effect in B amperes	Field current in F amperes	Primary current in A amperes	Increase of B's current on closing current of A amperes	Watts in circuit A	Watts in circuit B	Efficiency
11.0	950	$\frac{\pi}{2}$	0	0·7	5	0·8	2·2	32	19·3	60
15.0	1250	$\frac{\pi}{2}$	0	0·6	4	1·0	2·8	56	35	62
	"	1 section ∠ 20° at original mark	0	0·2	4	1·0	3·0	52	40	77
	"	"	0	0·2	4·1	1·0	3·1	52	43	83

29th Experiment. Set a wild plant (catnip) in a jar with its roots in gasolene, after having dried it first in the sun. The plant had shriveled somewhat before insertion but slowly recovered except the leaves and that part of the stalk that were in the jar. (Decay) finally set in after about 30 hours.

30th Tried the capillary power of Gasolene, Rhigolene and Water.

Took a tube 0.08 cm ($\frac{1}{30}$") diam, and put a portion of it vertically through the corks of each of 3 small phials containing respectively No 1 H_2O No 2 Rhig. No 3 Gasolene. The liquid rose in No 1 1.5 cms in No 2 0.4 cms. In No 3, 0.5 cm. Checked this by taking two plane glass plates and uniting two vertical edges. The plates were 10 cm. X 12 cm. and about 0.25" thick the angle being nearly 6°. The water rose the greatest. Next the gasolene, last the rhigolene. It seemed that the water took the longest time to assume the curve, gasolene the next and rhigolene the shortest time.

31st Took a small portion of cheese containing mite and poured a drop of gasolene (fr having microscopically) examined them. The effect of the drop was apparently to first stupify them but after about an hour, they recovered. The gasolene itself had by that time of course disappeared.

32nd Repeated this experiment with some other mite only using alpha naphthol. This seemed to have no effect.

33rd Tried similarly bichloride of mercury (strong solution in water). The effect of this on the mite was not apparent for about a minute and then they died.

34th Tried shigolene similarly. The effect of this was much more rapid, apparently dying instantly but after several minutes they seemed to revive and subsequently appeared unhurt. The drop of shigolene however soon disappeared by evaporation.

35th Tried the effect of gasolene in displacing water above it in a capillary tube. A glass tube 0.08cm (1/30") was partially filled with a column of coloured water and its lower end was then dipped in gasolene. No displacement was visible but slow diffusion took place.

36th Tried the effect of gasolene on the bacteria of some stagnant water. Added about equal small volumes of each. Microscopic examination seemed to show that the bacteria were killed.

37th Poured a solution made up of 50 c.c. strong comm. caustic soda and 350 c.c. Water on a small plot of weeds and grass about 60cm x 32

38th A very weak solution of caustic soda was added in drops to a drop of water having bacteria in active state. The bacteria seemed to be killed by the addition

600 grammes of pure $ZnSO_4$ obtained by Mr Watt from were added to 400 grammes of distilled water. A certain residue ~~was~~ of undissolved salt remained after much stirring and 12 hours solution at temp. of 20° C. The solution however now assumed to be (practically) saturated was filtered. It had increased between 50 and 100% in bulk but was quite transparent.

By floating hydrometer its spec. grav. was 1.14440 21.5°C
" weighing " " " " 1.14370 22° C.

Two pairs of 100 light meter plates were planed by machine and were varnished on the back and round the edge. The dimensions of each pair of plates appear in the following table.

Pair Marks	Mean length	Mean breadth	Mean area	Mean thickness	Mean inference left on one side	Mean inference left on other side	Mean inference distance	Lock Area above	Lock Area below	Wet lock Area
	cms	cms	sq. cms.	cms	cms	cms	cms	sq. cms	sq. cms	sq. cms
O	15.15	5.03	76.2 (3.9 / 72.3)	0.5	0.9168	0.9424	0.930	1.06	1.33	2.37
X	15.10	5.00	75.5 (2.3 / 73.2)	0.5	1.224	1.247	1.236	1.13	1.13	2.26

The plates were kept rigidly connected by means of two corks ~~with~~ screws through them the head and washer abutting on the backs of the plates. Strips of tape were laid against the sides of the plates to prevent circular conduction and the whole bound together with elastic bands. The top and bottom edges were not bound so as to allow free liquid passage. Since the bottom rest on the floor of the tank circular conduction can only take place at the top edge

The testing was conducted as follows:—
A clear beaker of following dimensions contained the solution.

Depth 17.6 cms.
Int. lower diam 7.0 -
" top - 7.2 -
Lip diam: 8.7.

The pair of plates were then immersed in the and measurements taken to three and four zero on the 3rd table bridge. Results follow.

Pair number	Time	Bridge etc.	Res. in cct.	Mass	Wetting F.Z.	Wetting T.Z.	Receding F.Z.	Receding T.Z.	Pole
O	10.0/22/9/11		8100	1	16.00	16.50	15.93	16.43	0.07
			1600	5	9.20	10.25	9.13	10.38	
		100 m/o T.B. 19.5°	750	10	5.80	6.67	5.73	6.60	
		Tension 21.00	122	50	2.35	2.86	2.28	2.79	
			5	250	0.60	0.72	0.53	0.65	
X	13.0/22.9.11		8000	1	7.50	8.40	7.43	8.33	0.07
		100 m/o T.B. 20°C		5	6.60	7.65	6.53	7.58	
				10	5.50	6.50	5.43	6.43	
				50	1.40	1.68	1.33	1.61	
				250	0.67	0.75	0.60	0.68	

These results seem to show a very imperfect contact between the plates, and the liquid especially in the first or O pair. The surfaces of the plates had been freshly cleaned with emery paper. They were not polished, but slightly and uniformly grooved throughout from the planer.

Calculations for the Dimensions of a Commutating Continuous Transformer of 100 light Capacity.

The coarse wire coil or secondary has to supply 50 amperes at 100 volts pressure at Machine terminals = 5100 Watts externally. The coils are to be simple Gramme rings. Suppose we give to the double Gramme ring an internal diam: of 30cms (12"), a rectangular cross section of core 6·3 cms (2½") by 2·5 cms (1") producing a mean diam: of 33 cms (13") and an external diam: (cms) of 35·6 cms (14").

The voltage at primary terminals to be 1000 and equal weight of copper to be in each coil:

To supply 6000 Watts odd the current in the primary coil must be 6 amperes. allowing 500 cir. mils to the ampere this means 3000 cir. mils = no. 17 wire B.W.G. or 0·058" diam: The length of one turn of this will be 7 cms. Assuming an average induction over the whole half ring of 1000 lines per sq. cm. and a velocity of rotation of 1200 turns per min. = 20 per sec: we have the relation

$$113 \times \pi \times 7 \times 1000 \times 20 = 1000 \times 10^8$$

$$\text{or in} = \frac{10^8}{1{\cdot}13 \times 7 \times 2{\cdot}00 \times 10^3} = \frac{10^4}{1{\cdot}3 \times 4{\cdot}4}$$

$$= \frac{10^4}{1{\cdot}72} = 5810$$

so that at the speed and induction named 5810 turns would suffice. Probably by means of the soft iron revolving frame the induction and active length of wire will increase so we will take the length of wire at 4000 turns.

The internal diam: being 30.4 cms (12") produces an internal circumference of 95.5 cm (37.7") and half of this or 47.8 cms (18.9") would be occupied by the fine wire coil. allowing reduction of 10% for insulating septa and the remaining length is 43 cms (or 17"). The area required for ~~#8~~ 40000 #17 B&S wire is $(0.058 + 0.010 = 0.068" \text{ Diam} = 3.63 \times 10^{-3} \text{ sq in.})$ $4 \times 10^3 \times 3.63 \times 10^{-3} = 14.52$ sq. in., thus requiring a thickness of nearly 1" in winding — (practically) prohibitive.

Suppose the linear dimensions of the machine to be therefore increased, say to 15" (38 cms) internal diam and 17" (43 cms) external diam. with a core whose cross section would be 2.5 cms × 6 cms 1" × 2½". The circumference would now be externally 135 cm (53.4") and with the same speed of revs (20 per sec) and induction 1500

$$n = \frac{10^8}{1.4142 \times 1.35 \times 7 \times 20} = \frac{10^8}{1.4142 \times 1.35 \times 1.4} = \frac{10^8}{1001.89} = \frac{5290 \times 3.3}{10}$$

Assuming 2000 turns of wire on each side of the primary, the internal circumference is 47.12" (119 cms) and half of this = 23.56" (59.5 cms) allowing, 10% for insulating strips, we have left 21.2" or 53.5 cms. This means 0.7" for depth of winding.

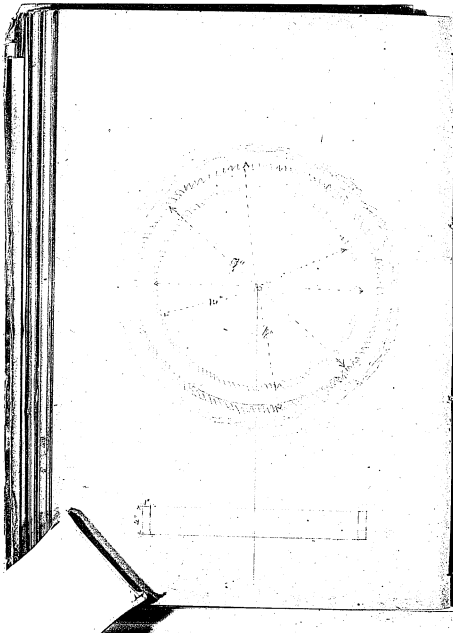
Next suppose 100 blocks in the commutator as in M, that will give 40 convolutions or an average of 20 volts per block.

2 × 2000 turns, each of say 5 ft. length give a total of ~~32000~~ 2800 feet of #17 B&S 0.058"

The weight of 1 foot is 0.01018 of 100 feet 10.18 lbs and 2800 feet = 28.5 lbs.

The wire to carry 50 amperes would at 500 c.m. = 25000 c.m. = #8 B&S 0.165" diam

To generate say 110 volts it would req



Data for a Continuous Commutating Transformer to yield 2.5 amperes at 102 volts

The inner diam = 15" (38.1 cms) = 47.1" (119.7 cms) circ.
Outer diam = 17" = (43.2 cms) = 53.4" (135.7 cms) circ.

At speed of 2000 per min. and 1500 inductors the number of turns required to produce 1000 volts

$$n \times 10 \times 1500 \times 2000 = 1000 \times 10^8$$

$$\therefore n = \frac{10^8}{3.0 \times 10^8} = 3333$$

Say that about twice the number or 7000 turns be employed since the two semicircles are in series. Since 25 × 110 or 2750 Watts have to be supplied to the secondary circuit we must arrange for 3 amperes at 1000 volts entering the primary circuit. Allowing 500 c.m. to the ampere we require $\frac{3}{2} \times 500 = 750$ c.m. in the wire = #22 wire B.W.G. 0.028" diam. Since the half internal circumference is 23.5", allowing 10% for insulating septa we have to coil 7000 wire each 0.040" diam upon a space of 21.2"

$0.04 \times 0.04 = 16 \times 10^{-4}$ sq. in. × 7000 = 11.200 sq. and this divided by 21.2 gives nearly 0.5" for depth of winding.

The length of this wire will be 7000 × (10" + 2") = 7000 feet. It weighs 2.373 lbs. per foot = 2.373 lbs per 1000 feet = 16.61 lbs. in all. The res. of 1 foot is 1.317×10^{-2} ω per foot = 13.17 ω per 1000 feet = 92.19 ω per 7000 feet = 23 ω on the whole gramme ring.

The length of the coarse wire must be at the first approximation $\frac{7000}{9}$ = 778 feet. To have the same weight 16.61 lbs it must

weigh $\frac{16.61}{778} \times 10^{-2} = 0.0214$ lbs per foot
= No 14 B.W.G or 0.083" diam.

Since the ceiling distance is 21.2" and we have to enter 778 turns upon it, each
0.095×0.095 sq. in $= 1.0 \times 1.0 \times 10^{-2} =$ ~~0.09 x 10^-2 = 0.09~~
778×0.09 ~~x 10^-2~~ $= 7.78$ ~~x 10^-2~~ $= 7.78$ sq. in.
This divided by 21.2 gives 0.37" as depth of winding. The area mult of #14 being .6889
this divided by 25 = 27.55 × 2 = 5.51 per ampere.
The res. of one foot of this wire being
1.499×10^{-3} 100' feet would have .1499 ω say 0.15 ω
and 778 feet would have 1.167 ω and the whole ring would have a res. of $\frac{1.167}{4} = 0.292$ ω
This multiplied by 25 = 7.3 volts drop of potential at full load = 111 − 7.3 = 103.7 volts at machine terminals, reduced perhaps still further by self induction.

The primary commutator to have 100 blocks like Mr. Edison, and the secondary to have 50 like Mr Edison.

The whole ring therefore to be divided into 200 ~~pole~~ segments and gramme wound.
The field ring to be subsequently discussed

The principal dimensions for the gramme ring then are

Internal. Diam of core 15" Height 4"
External " " 17"
Internal. Diam of ring wound about 14"
External " " " 15".

The Primary to consist of 7000 turns in feet of #22 B.W.G wire 0.025" diam. having a total weight of 16.6 lbs and a res. of 23 ω.

The Secondary to consist of 990 turns of feet #14 B.W.G wire 0.083" diam. having a total of 16 odd lbs and a res. of 0.25 ω

Sunday 23rd September

The last weighing of the two hot and cold meters not having been successful, Weighed the plates again after amalgamation.

17.30. No. 1 87.2018
2 88.3007 } 175.5010 observed
sum 175.5025

3 89.4658
4 89.9314 } 179.3960
sum 179.3972

5 87.9560
6 88.7720 } 176.7244
sum 176.7280

7 87.9807
8 85.8539 } 173.8351
173.8346

Sensitiveness of balance as follows.
@ 88 grammes load zero ± 12 per mgm.
@ 175 " " " ± 6 " "

Set up these better in order, with the heads of the screws against the odd numbers.

1+2 3+4 were put with in the water with the burning lamp
5+6 7+8 were put in the water with no lamp burning.

Current commenced 7 o'clock Monday 24 9.
Current 3.8 ampère Temp in Warm meter about 42°C
" Cool " 19°C

Monday 24th September.

Trial of new phonograph motor.

Res: of armature 0.216 ω
Field

A cell with new zinc and fresh solution made up in the phonograph room failed to work the machine for many minutes together. Tried a #18 solution that had been preserved.

11.30 Commenced running off

Time	Volts	Ohmes	Amp	Governing Speed	Watts	Temp.
11.30	1.51	~~[illegible]~~	2.5	188	3.78	0
12.00	1.394	0.47	2.61	188	4.16	
13.00	1.59	0.45	2.50	180	3.97	
14.00	1.574	0.45	2.50	180	3.94	
15.00	1.542	0.435	2.41	180	3.77	
16.00	1.504	0.440	2.44	180	3.69	
17.00	1.478	0.420	2.33	180	3.44	
18.00	1.423	0.440	2.44	176	3.47	
19.00	1.237	0.460	2.55	176	3.15	
20.00	1.228	0.450	2.61	176	3.21	
21.00	0.966	0.440	2.44	96	2.43	

Bell stopped running shortly afterwards.
The chromic acid solution completely exhausted

Total number of turning off completed

199

Tuesday 25th September.

Statement and Record of work for one complete day) in Engine and Boiler at Laboratory) commencing at 6.30 on the 24th inst.

Conditions

Two boilers fed during the day. Every barrow of coal was weighed and made up to 260 lbs. The ashes were also weighed.

Every lb: of water that entered the feed was recorded.

No steam was allowed to leave the boilers to supply any of the outbuildings or storeys. All the steam was fed to the engines

Diagrams were taken of both Arm-Simms Engine + the Brown Engine from time to time.

The results are shewn in the following table:—

Engine started at 7.20
Brown + No 1 - - stopped at 12.0
- - - - - - started at 12.30
No 2. A.S. started at 17.40
Brown stopped at 18.00
Brown started at 18.52
Brown stopped at 19.10
Brown started at 19.16
- stopped at 22.00
No 1. A.S. stopped at 1.00
- 2 - - - 1.50.

Boiles in same condition at close as at commencement.

26 barrows of coal were burnt each weighing 260 lbs = 6760 lbs
day 6800 -

Total ashes reduced 792 day 800
Coal burnt 6000.

Total lbs. of water 57,000 lbs.
137 barrel each of 52 gall. or 416 lbs.

The Brown engine ran 13 hours
- A.S. no 1 - 17 -
- A.S. - - - 2 - 8 1/2

The HP hrs accounted for are 66 + 3149.6 = 584
Added to this the 225 HP. by the Brown = 809
or in fact out of 919 HP 584 are accounted for

Time	Engine running						Amperes indicated	
	Brown		A.S. no 1.		A.S. no 2			
	I.H.P	Est. H.P.	I.H.P.	Est. HP.	I.H.P.	Est. HP.	No 1.	No 2.
7.0	0	0	0	0			75	
8.0		7.5		22.0			150	
9.0		18.0		44.0			150	
10.0		18.0		44.0			150	
11.0		18.0		43.8			150	
12.0		18.0	44.6	44.6			150	
13.0		8.0		22.0			75	
14.0	18.5	18.5		45.0			150	
15.0		18.5	39.7	39.7			125	
16.0	20.1	20.1		47.5			128	
17.0	14.9	17.5	43.3	43.3			130	
18.0		15.0		43.3	28.1	27.7	140	137
19.0		22.0		44.0	29.0	29.0	140	145
20.0		15.0		44.0	29.0	29.0	140	145
21.0	14.6	14.6		44.0		29.0	150	136
22.0	17.6	16.1		45.0	24.4	26.5	150	108
23.0				40.0	20.4	20.4	115	70
24.0				40.0		16.0	115	60
1.0				40.0		16.0	115	50
2.0						14.0	~~105~~	~~50~~
		224.8		730.2		189.6	1145.8	791

Total H.P. hours 1144.6
Coal burnt 6000
Coal per H.P. 5.24 lbs.
lbs. of water 57000
lbs. of water evaporated per lb. of coal 9.5

Meter work. continued.

25th September 1888.

Washed the two pairs of 100 light plates in dilute caustic soda and amalgamated them. By means of the hard rubber washers, the intervening space was made 0.635 cms for pair X and 1.270 - - " O.

Mica strips were applied as usual.

Took following series — Pair X T.B. 18°C.

No.	Time	Bridge ft	Res.	Max	T.X.	Primary F.X.	Secondary T.X.	Secondary F.X.	Spec. R.
1	9.15	1000/10	7900	1	0.63	0.50	0.54	0.41	
2		Temp at 18°C.	770	10	0.62	0.56	0.54	0.47	2.76 x10
3			115	50	0.605	0.58	0.52	0.49	
4		Xcmple	4	250	0.587	0.568	0.50	0.48	
	Wint	solution							
1	10.00	1000/10	7400	1	0.66	0.60	0.67	0.51	2.95x10
2		Temp at 15.6°C.	720	10	0.62	0.60	0.53	0.51	
3			117	50	0.605	0.595	0.52	0.51	
		Xcmple							
	Wilmotti	solution							

The sp. g. of the Wint Solution by Hydr. 1.444 @ 15.8°C
" " " " Wilmotti " " 1.433 @ 15.6°C
" Hight 1.473 @ 17.0°C

1	10.25	1000/10	7600	1	0.345	0.345	0.26	0.26	
2		Temp at 16°	740	10	0.405	0.36	0.32	0.27	
3			120	50	0.39	0.37	0.30	0.29	
4		Xcmple	5	250	0.377	0.36	0.29	0.28	
		Wint solution							

Repeated results with solutions maintaining however a constant current and altering the temperature.

No	Time	Bulb temp.	Max.	T. cell	Observed T.Z.	Observed F.Z.	Corrected for the bulb T.Z	Corrected for the bulb F.Z.	Sl. P.
1	11.27	5 Early 100 Pm T.B. 1.40 95	50	60°c.	0.875	0.865	0.108	0.095	~~4.64~~ 11.36
2	12.03	100	50	50°c.	0.912	0.900	0.125	0.133	15.40
3	13.20	95	50	38.8°c	0.995	0.980	0.228	0.213	24.66
4	14.25	100	50	7.0°c.	1.895	1.895	1.128	1.128	130.6
5	10.25		50	16°c.			0.30	0.29	33.6
1	11.20	95	50	60°c	0.960	0.960	0.193	0.193	11.2
2	12.00	110	50	50°c	1.013	1.00	0.246	0.233	13.5
3	13.23	95	50	38.5°c	1.140	1.130	0.373	0.363	21.6
4	14.20	100	50	7.0°c	2.200	2.160	1.433	1.393	80.7
5	9.15		50	16.8°			0.52	0.49	28.4

The temperature of the cells was raised to 60°c by immersing it in a vessel of hot water. The temp. was read between the plates. The res. at the lowest temp (7°) may have been increased by the crystallization that took place there. Solution with their bulb.

Two thermometer were successively set in a cup in ice. The zero thermometer then indicated to 3 - 5° " " " - 0.2

Tuesday 25th September.

Ran another same phonograph motor as in the last test with a fresh zinc and solution and all other conditions maintained except that the speed was kept by the governor at 125 revs. per min. The following is a statement of the results obtained, also plotted on the accompanying curve:—

No. of Det.	Time	Speed	Black Def.	Ampere	P.D. at machine terminals	Watts in machine
1	11.00	125	0.44	2.44	1.646	4.016
2	12.00	"	0.445	2.47	1.634	4.036
3	13.00	"	0.43	2.38	1.642	3.91
4	14.00	"	0.44	2.44	1.634	3.99
5	15.00	"	0.45	2.50	1.594	4.20
6	16.00	"	0.445	2.47	1.560	3.85
7	17.00	"	0.44	2.44	1.526	3.72
8	18.00	"	0.43	2.38	1.489	3.54
9	19.00	"	0.44	2.44	1.368	3.34
10	20.00	"	0.44	2.44	1.342	3.27
11	21.00	"	0.445	2.47	1.206	2.98
12	22.00	116	0.415	2.31	1.021	2.36
13	22.15	52	0.410	2.27	0.523	1.19
	Total	no. of	eggs	burning off	completed	165

Gasolene experiments contd.

Prepared following estimate of lowest possible commercial prices of prophylactics :—

Bromine	37 cts per lb.
Chloride of lime	2 . . .
Chlorine Water	10 . . .
10% Solution Caustic Soda using 48% Crude	0.25 . . .
Gasolene	1.
Rhigolene	16
Bisulphide of carbon	10
Corrosive sublimate	57

1 U.S. gallon will cover 1.2 sq. yds to a depth of 1/8".

Sept. 25th. Mounted a new specimen of chaoemites under the 40 dam power of microscope. They were alive and active. Poured a few drops (perhaps 2) gasolene over them. This stupefied them for a time but they afterwards entirely recovered.

(2) After their revival poured one or two drops of 20% (about) solution Caustic Soda all the mites died within 15 mins.

(3) Mounted another specimen of live mites and treated them with a drop of solution composed of 5 cc. H_2O 10 drops gasolene + 10 drops NaHO. This was not fatal.

(4) Mixed equal volumes of gasolene + caustic soda. Then used a drop of so of the above solution on another specimen. This rendered them motionless for about 15 mins but they recovered.

Meter experiment continued.

27th left:
Found lamp in hot meter under test broken at about 9.20. It was burning last night so that only a few hours of heat have been lost.

Prepared a new solution as follows:—
Took 450 c.c. of the concentrated sol. whose sp. gr. was measured again as follows—

1.430 @ 25°C by balance
1.440 @ 23.8°C - Hydrometer
1.440 @ 23.8°C - - from Pharm. Rom.

added to this 50 c.c. of distilled water
So that the solution is now 90% of its previous strength.
The sp. gr. of the new solution was

1.401 @ 24.5°C by balance
1.410 @ 23.8°C - Hydr.

Revarnished zinc plate with some of Mr. Hall's varnish.
Set aside in a labelled bottle about 100 c.c. of the primitive solution.

26th Sept.

Received a complete set of Becker Scale + weight from the Edison Co. through Mr Wirt. The 1mgm + riders only) missing.

Tested the weights as follows –

The 500 gramme weight is 0·001 less than sum
2nd 200
100
100
chemical 100 500

" 200 " " " 0·001 less than sum of
100
100 200

" two 100 " " " are practically) equal.

" 100 " " are about 0·001 more than the collective 100.
50
20
10
10
5
2
2
1 100

The sensitiveness of the balance is

8 per mgm @ 500 gramme load.
15 " " @ 200 " "
18 " " @ 100 " "

The periodic time of one complete vibn of the balance is 52·3 secs approx @ 100gm load.

Gasolene experiment contd.:

(5) Used equal volumes of 90% caustic soda + H_2O. Treated another specimen with this & found it fatal.

(6). Used solution of 90% H_2O 10% $NaHO$ on another specimen & found it fatal.

(7). Made a solution of sp. g. 1.067 same 10% solution & found it invariably fatal in mins.

(8) 23rd Sept. 14.0. Prepared 3 small grass plots each about 50 cms × 50 cms. = 2500 sq. cms & poured upon on $NaHO$. 10% Solution 1500 cc.
on the second Gasolene 1500 cc
on the third Half Gasolene & half 10% $NaHO$ 1500 cc.
On the 26th. The effect was visible
" 27th. The $NaHO$ appeared to have been most active then the gasolene, & the mixture best. All had been fairly fatal to the grass. Depth of imaginary layer 0.6 cm.

26th Septr. Poured an egg into water after stirring it to purify).

27th Septr. Tested a drop of stagnant water under 500 power of microscope & found it to contain bacteria. Then added a drop of gasolene & could find no more movement in them.

Tried 10% $NaHO$ with equal success.

Set 3 solutions to purify in corked bottles set in a battery jar round an Edison lamp feebly illuminated to sustain life.

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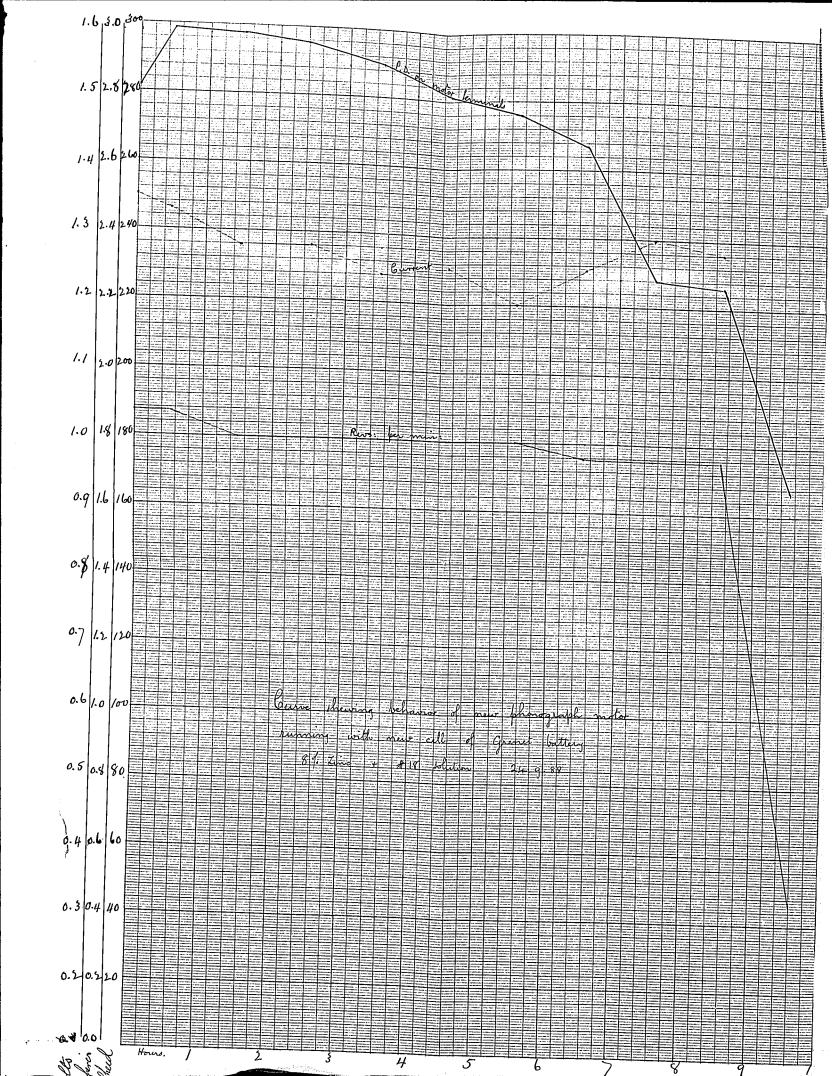

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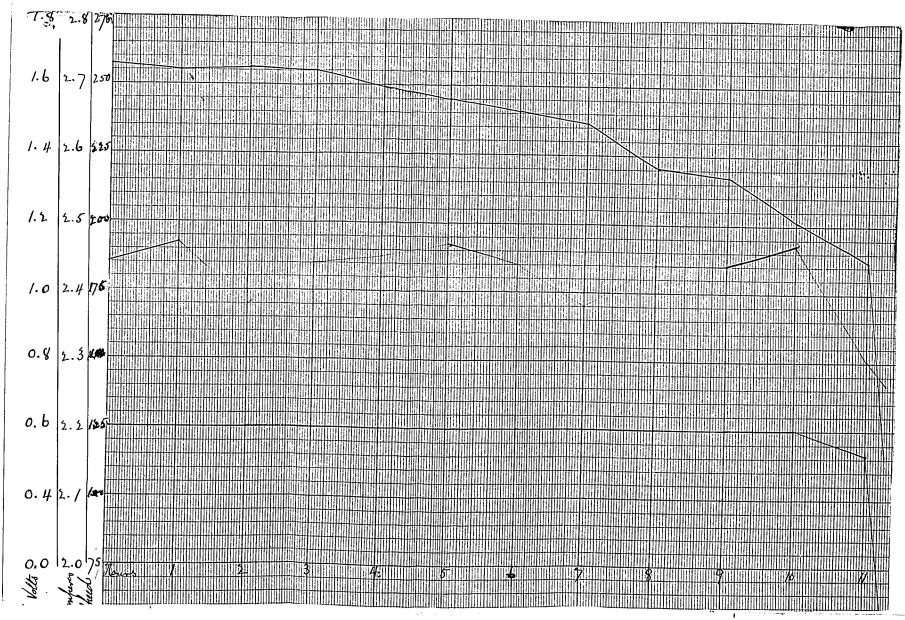

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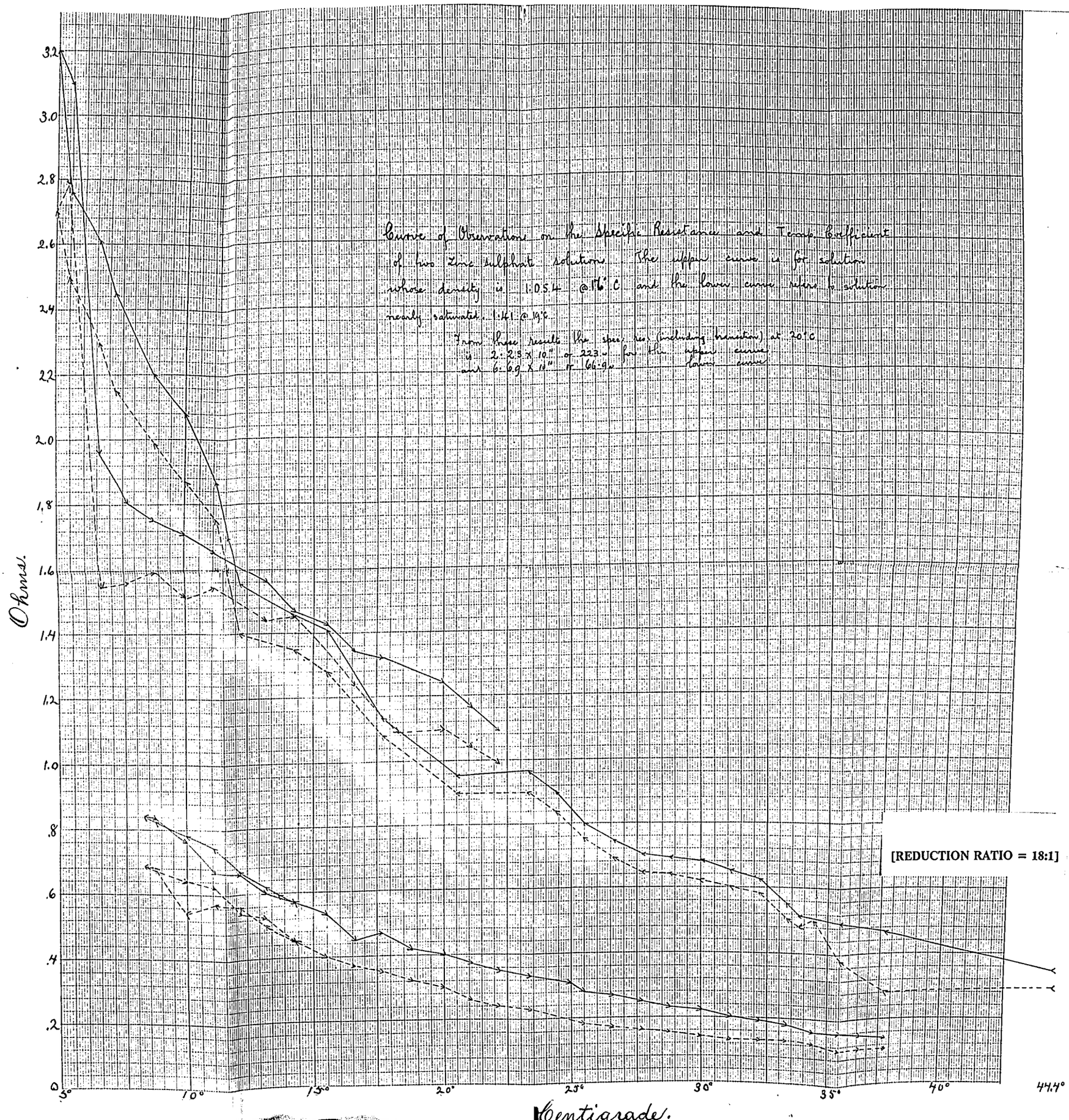

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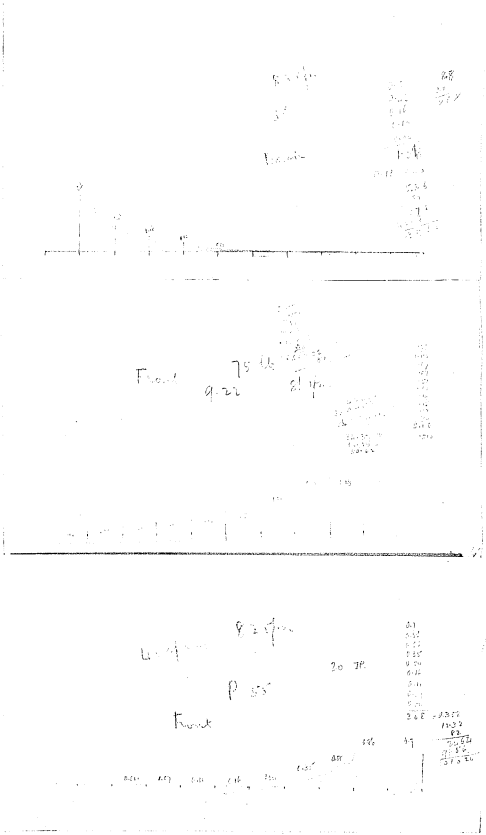
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